REPORT

Feasibility Study Report

Kerr-McGee Chemical LLC
Kress Creek/West Branch DuPage River
and Sewage Treatment Plant Sites
DuPage County, IL

May 2004

BLASLAND, BOUCK & LEE, INC.
engineers, scientists, economists

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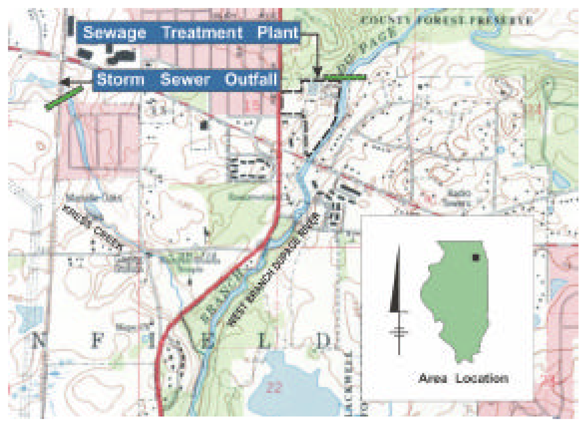
Introduction

Historical operations at the West Chicago Rare Earths Facility (REF) – where thorium and other elements were extracted from monazite sands, bastnasite, and other ores between 1932 and 1973 – and the West Chicago Sewage Treatment Plant (STP) – which received debris and waste from the REF – resulted in the distribution of low level radioactive thorium residuals in portions of Kress Creek, the West Branch DuPage River, and their associated floodplains. Commencing in March 1976, Argonne National Laboratory (ANL) conducted a study on behalf of the U.S. Nuclear Regulatory Commission (NRC). The NRC study was an initial base-line study to identify and briefly characterize contaminated properties in the vicinity of the REF. The locations investigated by ANL included the STP and Kress Creek. Techniques used to delineate the contaminated areas included an Aerial Radiological Monitoring Survey (ARMS) flyover in 1977, a street-by-street instrumented vehicle survey, an external gamma exposure rate survey, soil contamination measurements using subsurface sampling, and a radiological walkover survey along the waterways and banks of Kress Creek and parts of the West Branch DuPage River. Since 1993, Kerr-McGee Chemical LLC (Kerr-McGee) and the U.S. Environmental Protection Agency (USEPA) have conducted a number of investigations of the sediments and floodplain soils in and along portions of Kress Creek and the West Branch DuPage River in DuPage County, Illinois. This Feasibility Study (FS) Report presents the development and evaluation of four potential remedial alternatives designed to address the contaminated sediments and floodplain soils at two vicinity property sites placed on the National Priorities List (NPL) – the Kress Creek/West Branch DuPage River Site (Kress Creek Site) and the river portion of the STP Site, collectively referred to as the Sites. The Upland STP[1] is being addressed by a removal action under a separate Administrative Order on Consent dated October 16, 2003, and is therefore not considered in the FS analyses.



Location of the northern portion of the Sites in DuPage County, Illinois

The Kress Creek Site includes approximately 1.5 miles of Kress Creek from near the REF to the confluence with the West Branch DuPage River, and approximately 5.2 miles of the River from the confluence downstream to McDowell Dam. The STP Site includes approximately 1.2 miles of the River from the northern boundary of the STP downstream to the confluence with Kress Creek, as well as the 25-acre STP.

Background – The Current Situation at the Sites

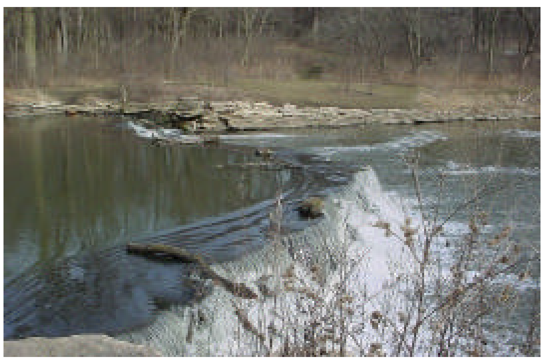
The contaminants of concern at the Sites are residuals – predominantly fine particles and tailings – from the historic processing of thorium-containing monazite ores at the REF, including radionuclides in the thorium decay chain and elemental metals associated with the thorium-containing ores. These contaminants are present in the soils and sediments in and along the River and Creek. A number of investigations designed to

[1] Sewage Treatment Plant Upland Operable Unit (Upland STP) shall mean the approximately 25 acres where the West Chicago Sewage Treatment Plant is located at Illinois Routes 59 and 38, Sarana Drive, in the City of West Chicago. The eastern boundary of the STP Upland OU is designated by a black line of dashes set forth on the map attached as Appendix C of the AOC dated October 16, 2003, except however, that the eastern portion of the STP Upland OU also includes the bank area where Waste Materials are located around or beneath the West Chicago Sewage Treatment Plant NPDES discharge pipe as it enters the West Branch of the DuPage River.

characterize the Sites – including gamma walkover surveys and soil boring installations – have been conducted over the past decade by NRC, USEPA, and Kerr-McGee.

The results of these investigations, which are summarized in the Remedial Investigation (RI) Report developed for the Sites (BBL, 2004), indicate that the highest radioactivity levels of thorium residuals at the Sites are in the soils and sediments in and along Kress Creek, but decrease with distance downstream to the confluence with the West Branch DuPage River. The radioactivity levels detected throughout the West Branch DuPage River – which are highest in the soils and sediments near the STP and decrease with distance downstream to and below the confluence – are lower overall than in Kress Creek. In the contaminated floodplain soils of the Sites, the higher radioactivity levels are generally present closer to the water, decreasing with distance out into the floodplain.

Solids transport is the primary fate and transport mechanism that affects the levels of thorium residuals in the sediments and floodplain soils of the Sites. The residuals are present as fine-grained materials that were scoured from the sediment bed and the Creek/River banks during high flow events, and then either deposited in downstream floodplain areas (if the flow was high enough to overtop the banks) or settled out in quiescent areas of the River and Creek – particularly in the impounded areas behind McDowell and Warrenville dams – and along the inside of river bends. This tendency toward deposition caused contaminated sediments and soils to accumulate in certain areas of the Sites. After production at the REF stopped in 1973, the downstream transport of residuals declined, and, in places, materials were deposited on top of the contaminated layer. While the thickness of this overburden layer varies, it is between 0.3 and 1.2 feet on average, with the thickest layer (2.8 feet average) in the impounded area behind McDowell Dam. At 2.3 feet (average), the layer of contaminated materials is thickest in the sediments in the impounded area behind Warrenville Dam, compared to an average thickness of 1.1 to 1.4 feet in the rest of the Sites.



A view of the Warrenville Dam on the West Branch DuPage River.

The findings related to the nature and extent of contaminated materials and the fate and transport of the contaminants of concern, which are discussed in more detail in the RI Report (BBL, 2004), are used in this FS Report to identify the materials at the Sites potentially subject to remediation and to determine the appropriate range of potential remedial alternatives. The process of developing the remedial alternatives and evaluating them in relation to the criteria specified in the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) is described in detail in this report and summarized below.

Kerr-McGee is performing additional characterization (i.e., surface scanning and if necessary, subsurface delineation) in specific areas of the Sites, including the stretch of the River between the Warrenville and McDowell dams. The findings from this future characterization could modify the extent of materials potentially subject to remediation at the Sites; however, it is not anticipated that the findings would affect the selection of a remedial alternative. Any modification to the extent of materials potentially subject to remediation would be considered, as appropriate, during the detailed design of the selected remedial alternative.

Remedial Action Objectives

Remedial action objectives (RAOs) are site-specific goals developed to address potential human health and ecological risks and are considered in the individual and comparative evaluations related to the effectiveness of the potential remedial alternatives (see Section 2.2). The RAOs for the Sites were developed based on applicable guidance and regulations, experience at the REF and other Kerr-McGee NPL sites, and goals for future use of the Sites. The RAOs are:

1. Reduce risks to human health and the environment presented by sediments and floodplain soils containing elevated levels of total radium by reducing soil concentrations to levels that are consistent with the requirements outlined in 40 CFR Part 192 (the regulations implementing the Uranium Mill Tailings Radiation Control Act [UMTCRA]) and Illinois Source Material Milling Regulations; and

2. Mitigate, to the extent practicable, potential adverse effects to the environment as a result of implementation of remedial activities at the Sites.

Development of Potential Remedial Alternatives

To accomplish the remedial objectives for the Sites and protect human health and the environment, specific remedial technologies and strategies were developed and evaluated (see Section 3). For the Kress Creek and STP Sites, nine overall categories of technology options – called general response actions or GRAs – were identified as ways to potentially manage site risks, ranging from No Action to Sediment/Soil Removal. Within the nine categories of GRAs, 30 specific process options (see Table 3-1) were initially selected; of these, 25 were deemed to be potentially feasible, and were evaluated based on effectiveness, implementability, and relative cost (see Table 3-2). Twelve representative process options (see Table 3-3) were considered to strike the best balance among the three evaluation criteria; these options were then used as "building blocks" and assembled into four potential remedial alternatives for the Sites. Each alternative is briefly described below.

Alternative 1 – No Action

- No active remediation
- Site-wide natural recovery through natural physical and chemical processes

Alternative 2 – Monitored Natural Recovery

- No active remediation
- Site-wide natural recovery through natural physical and chemical processes
- Ongoing monitoring of natural recovery processes throughout the Sites

Alternative 3 – Excavation and Off-Site Disposal of Sediment/Soil throughout the Sites

- Excavation of approximately 77,000 cubic yards (cy) sediment and 48,000 cy floodplain soils in the dry
- Excavated materials gravity dewatered in staging areas
- Excavated materials confirmed as overburden reserved for use as backfill
- Excavated materials with confirmed radioactivity level >7.2 picoCuries per gram (pCi/g) properly disposed off-site
- Floodplain areas backfilled to original grade; sediment areas only backfilled where necessary for stability
- Impacted areas restored
- Monitoring conducted during implementation; periodic post-remediation monitoring of stabilized and restored areas

Alternative 4 – Capping of Sediment/Soil throughout the Sites

- Engineered caps constructed over 13 acres of floodplain and 9 acres of sediment
- Excavation of approximately 45,000 cy sediment and 40,000 cy floodplain soils to facilitate capping
- Excavated materials confirmed as overburden reserved for use as backfill
- Excavated materials with confirmed radioactivity level >7.2 pCi/g properly disposed off-site
- Impacted areas restored
- Monitoring conducted during implementation; long-term monitoring/maintenance of caps and stabilized/restored areas
- Institutional controls implemented to maintain cap integrity

Evaluation of Remedial Alternatives

The four potential remedial alternatives were subjected to a detailed evaluation – both individually (see Section 4) and comparatively (see Section 5) – against seven of the nine key decision-making criteria required under CERCLA and the NCP. The two modifying criteria, acceptance by the State (support agency) and the community, will be addressed by USEPA in the Record of Decision (ROD) for each Site after an opportunity for public comment on the proposed plan. The results of the evaluations are summarized below.

The confluence of Kress Creek and West Branch DuPage River.

Overall Protection of Human Health and the Environment

Alternative 3 would likely afford the highest degree of overall protection since its implementation would result in the excavation and permanent off-site disposal of the largest amount of contaminated sediments and floodplain soils. Alternative 4 could provide overall protection; however, substantially smaller quantities of contaminated materials would be removed and engineered caps and institutional controls, including deed/access restrictions and maintenance of dams, would be necessary to provide long-term protection.

Alternatives 1 and 2 could provide an appropriate level of protection for human health and the environment, but the natural recovery processes these alternatives rely on would have to continue for a long time before radium-in-soil concentrations are reduced to the levels that will be achieved relatively quickly under Alternative 3.

Compliance with ARARs

The action-specific and location-specific applicable or relevant and appropriate requirements (ARARs) identified for the Sites could likely be achieved through proper design of either Alternative 3 or 4. These same requirements do not apply to Alternatives 1 or 2 since no active remedial measures are included in these options. Of all the alternatives, Alternative 3 would meet the State and Federal chemical-specific ARARs in the shortest period of time.

Long-Term Effectiveness and Permanence

Implementation of Alternative 3, resulting in the excavation and off-site disposal of contaminated sediments and floodplain soils at the Sites, would provide the highest degree of long-term protection and permanence of the four potential remedial options. Alternative 4 would perform well (65% of the contaminated materials would be removed and disposed off-site), however, since radioactive materials would remain at the Sites under engineered caps, institutional controls and monitoring would be necessary to provide an appropriate degree of protection.

The monitoring component of Alternative 2 would provide valuable information regarding the progress of natural recovery at the Sites; however, since neither Alternative 1 nor Alternative 2 contain any active measures, a long time period would be necessary until the effectiveness and permanence comparable to that achieved by either Alternative 3 or 4 would be attained.

Reduction in Toxicity, Mobility, and Volume through Treatment

Although none of the alternatives include a treatment component, each one would provide some degree of reduction in toxicity, mobility, and volume of contaminated materials. Alternatives 1 and 2 would result in decreased volume and toxicity through half-life decay, and ongoing sedimentation and deposition would decrease mobility. Implementation of Alternatives 3 and 4 would provide additional reductions in both volume and mobility via excavation and disposal of contaminated materials at a licensed disposal facility.

Short-Term Effectiveness

The potential short-term impacts and risks associated with the active components of Alternatives 3 and 4, including alteration/disruption of the benthic habitat, increased risk of localized flooding, increased truck traffic, and disruption of recreational activities on the Creek/River would last for the duration of implementation. Use of appropriate health and safety practices would adequately protect remediation workers and local residents from any risks associated with exposure to low levels of thorium residuals. There would be no short-term impacts or risks associated with implementation of Alternatives 1 or 2 since neither includes any active remedial measures.

Implementability

All four alternatives are technically implementable, and the necessary goods, services, equipment, and materials are readily available. Implementation of Alternatives 2 and 4 could present administrative issues due to the necessity for institutional controls, including deed and access restrictions and dam maintenance requirements.

Cost

The estimated present worth costs to implement the four potential remedial alternatives are as follows (in millions of dollars):

- Alternative 1: $0
- Alternative 2: $0.4 M ($0.35 M for the Kress Creek Site and $0.05 M for the STP Site)
- Alternative 3: $73.7 M ($71.9 M for the Kress Creek Site and $1.8 M for the STP Site)
- Alternative 4: $67.1 M ($65.5 M for the Kress Creek Site and $1.6 M for the STP Site)

Summary

Results of investigations conducted since 1993 indicate the need to address certain floodplain soils and sediments at the Sites. The four potential remedial alternatives developed and evaluated in this FS Report represent the broad range of options that could be implemented to address Site risks. Based on the detailed and comparative evaluations presented in Sections 4 and 5, respectively, the two alternatives with active remedial components (Alternatives 3 and 4) likely offer enhanced overall protection, long-term effectiveness, and permanence in a relatively short time frame (32 months) compared to Alternatives 1 and 2. Of the two active remedial options, Alternative 3 would result in substantially more excavation and off-site disposal of contaminated materials for a relatively minor increase in cost

Kress Creek from the outfall.

(approximately 10%) compared to Alternative 4. The No Action and Monitored Natural Recovery options would eventually provide adequate protection, but the long time frame necessary to achieve the goals for the Sites make these options less desirable.

1. Introduction

1.1 Purpose and Organization of Report

This Feasibility Study (FS) Report presents the development and evaluation of potential remedial alternatives for the Kress Creek/West Branch DuPage River Site (Kress Creek Site) and the river portion of the West Chicago Sewage Treatment Plant Site (STP Site), both located in DuPage County, Illinois. These two sites are collectively referred to as the "Sites" in this report, and are depicted on Figure 1-1. The Remedial Investigation (RI) Report developed for the Sites (Blasland, Bouck & Lee, Inc. [BBL], 2004) presented findings of various past studies including an extensive site characterization conducted by Kerr-McGee Chemical LLC (Kerr-McGee), starting in 1997. These findings, in combination with the baseline human health and ecological risk assessments prepared by the U.S. Environmental Protection Agency (USEPA), indicate that remedial action is warranted to address certain sediment and floodplain materials at the Sites. It is anticipated that removal activities for the Upland STP[1] (STP) will eliminate the need for further response action at that location. Upland STP removal activities are being carried out pursuant to an Administrative Order on Consent (AOC) dated October 16, 2003 and that area of the STP Site is excluded from the analyses presented in this FS Report.

BBL prepared this report on behalf of Kerr-McGee consistent with the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (40 CFR Part 300, Subpart E) and the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act (SARA) of 1986.

The potential remedial alternatives presented in this report are designed to protect human health and the environment by implementing measures consistent with requirements outlined in 40 CFR Part 192 (the regulations implementing the Uranium Mill Tailings Radiation Control Act [UMTRCA]) and Illinois Agreement State requirements found in the Illinois Uranium and Thorium Mill Tailings Control Act, Radiation Protection Act of 1990, and the State's implementing regulations for licensing of Source Material Milling Facilities.

Section 1 of the FS Report contains background information and summaries of the nature and extent, as well as the fate and transport of contaminants at the Sites. In this context, contaminants refer to residuals predominantly fine particles and tailings - from the historic processing of thorium-containing monazite ores at the West Chicago Rare Earths Facility (REF) including radionuclides in the thorium decay chain and elemental metals associated with the same ores. Section 2 presents the development of Remedial Action Objectives and General Response Actions for the Sites, along with the identification of applicable or relevant and appropriate requirements (ARARs), other criteria and guidance to be considered (TBCs), and the specific areas of the Sites subject to evaluation. Technology types and process options are identified and screened in Section 3, then used to assemble potential remedial alternatives for the Sites. The various alternatives are then subjected to an initial screening process based on broad considerations of effectiveness, implementability, and relative cost. Finally, Sections 4 and 5 present the detailed and comparative evaluations of the retained alternatives relative to the CERCLA criteria of overall protection of human health and the environment; compliance with ARARs; long-term effectiveness and permanence; reduction of toxicity, mobility, or volume through treatment; short-term effectiveness; implementability; and cost. The USEPA will evaluate two additional criteria - State (support

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agency) acceptance and community acceptance, after public comments and input are received and compiled on the Proposed Remedial Action Plan.

1.2 Background Information

1.2.1 Site Histories

From about 1932 until 1973, thorium and other elements were extracted from monazite sands, bastnasite (rare earth ore), and other ores at the REF. Thorium was used in the manufacture of gas mantles, and thorium, radium, uranium, and rare earths produced were supplied to both private parties and the government for various purposes. Lindsay Light and Chemical Company operated the REF from 1932 until 1958. After a corporate merger, the American Potash and Chemical Company became owner of the REF in 1958. Kerr-McGee acquired the REF in 1967 and operated it on a limited basis until its closure in 1973.

Starting in 1954, production of thorium was subject to federal regulation under the U.S. Atomic Energy Commission (AEC). In 1974 (just after the closure of the REF), licensing and regulatory authority was transferred to the U.S. Nuclear Regulatory Commission (NRC). Commencing in March 1976, Argonne National Laboratory (ANL) conducted a study on behalf of the NRC. The NRC study was an initial base-line study to identify and briefly characterize contaminated properties in the vicinity of the REF. The locations investigated by ANL included, the Sewage Treatment Plant, and Kress Creek. Techniques used to delineate the contaminated areas included an Aerial Radiological Monitoring Survey ("ARMS") flyover in 1977, a street-by-street instrumented vehicle survey, an external gamma exposure rate survey, soil contamination measurements using subsurface sampling, and a radiological walkover survey along the waterways and banks of Kress Creek and parts of the West Branch DuPage River. The State of Illinois petitioned the NRC for licensing authority for the REF, and the Illinois Department of Nuclear Safety (IDNS) was granted that authority on November 1, 1990. The facility is currently covered by license STA-583 and amendments thereto issued by the IDNS. As of July 1, 2003 the IDNS was abolished and merged into the Illinois Emergency Management Agency (IEMA). The IEMA Division of Nuclear Safety (DNS) now has the licensing and regulatory authority for the REF.

Tailings generated at the REF contained low levels of residual thorium and radium. The tailings were stockpiled at the REF and subsequently used as fill material at various vicinity locations in and around West Chicago, including the STP Site. During the past 15 years, under agreement with the City of West Chicago and certain Unilateral Orders issued by USEPA and oversight of the IEMA/DNS, much of the material has been excavated and returned to the REF, where the materials were prepared and shipped to a permanent off-site disposal facility licensed to handle radioactive materials.

The STP, which covers approximately 25 acres, was built in 1919. From approximately 1932 through 1973, the STP received wastes from a variety of sources. Some debris and wastes from the REF were placed at the STP. Radioactive ore, tailings and process wastes from the REF were used as fill, to contour grounds, and were mixed with landfill wastes. This material was also used as fill along approximately 320 feet of riverbank. As a result, soil and sediment at the STP Site contain low level radioactive contamination (BBL, 2004). Much of these materials were removed under an agreement with the City of West Chicago and returned to the REF in the late 1980s. Cleanup of certain additional materials at the Upland STP property is being addressed separately under an AOC between Kerr-McGee and USEPA. The remedies developed and evaluated for the STP Site in this report are focused on the river portion of the STP Site.

The primary source of radionuclides in Kress Creek was surface drainage from the REF that was conveyed by a storm sewer directly to the Creek (BBL, 2004). Over time, materials containing low levels of radioactive thorium residues were distributed in the Creek, River, and some floodplains. Some materials from the STP also were distributed in the River above its confluence with Kress Creek.

The Kress Creek Site and the STP Site are two of the four vicinity properties that are on the National Priorities List (NPL) in the West Chicago area affected by materials originating from the REF. The other two NPL sites – Reed-Keppler Park and the Residential Area Sites – have been addressed separately. Removal activities at Reed-Keppler Park were completed between 1997 and 2000, and USEPA issued a Record of Decision (ROD) on September 13, 2002 that called for no further action, except for limited groundwater monitoring. For the Residential Area Site, USEPA investigated more than 2,170 properties, and identified 676 with contamination that needed to be addressed. Kerr-McGee has completed cleanup at 672 of those properties under a removal action. The remaining four properties have unresolved access issues currently preventing cleanup of those properties. USEPA and Kerr-McGee intend to complete cleanup activities at those properties as soon as access issues are resolved. USEPA issued a Proposed Plan for the Residential Areas Site on July 10, 2003 and issued a ROD on September 29, 2003 that called for no further action at the site after completion of the removal action.

1.2.2 Site Descriptions

The Kress Creek Site and the STP Site, collectively referred to as the Sites, are described below. The reaches introduced in the RI Report were used primarily to facilitate description and analysis of the data. The reach descriptions have not been retained in the FS analyses since only Site-wide remedies are contemplated.

1.2.2.1 Kress Creek/West Branch DuPage River Site

The Kress Creek Site encompasses two areas – 1) approximately 1.5 miles of Kress Creek, stretching from the storm sewer outfall located south of Roosevelt Road on the east side of the Elgin-Joliet and Eastern (EJ&E) Railway to Kress Creek's confluence with the West Branch DuPage River; and 2) approximately 5.2 miles of the West Branch DuPage River, from its confluence with Kress Creek to the McDowell Dam. The extent of the Site is depicted on Figure 1-1.

Land use along the Kress Creek Site includes residential areas, parks, a county forest preserve, and property owned by religious organizations and government agencies. The stretches of Kress Creek and the West Branch DuPage River within the Site flow under several bridges and traverse Manville Oaks Park, the Nichiren Shoshu Temple property, Roy C. Blackwell Forest Preserve, the Warrenville Cenacle, Warrenville Grove Forest Preserve, and McDowell Grove Forest Preserve.

1.2.2.2 West Chicago Sewage Treatment Plant Site

The STP Site includes the West Chicago Sewage Treatment Plant, which is owned and operated by the City of West Chicago (located at Illinois Routes 59 and 38, Sarana Drive in West Chicago), and approximately 1.2 miles of the West Branch DuPage River from the northern boundary of the STP property to the confluence of the West Branch and Kress Creek (see Figure 1-1). The Upland STP is being addressed by the aforementioned removal action while the River portion of the STP will be addressed by this document.

Land use along the West Branch DuPage River between the northern boundary of the STP property to the confluence with Kress Creek is predominantly recreational. The western bank adjacent to the STP facility is owned by the City of West Chicago. There are some homes and a church on the eastern side of the river between the STP and Gary's Mill Road, but only limited development exists from Gary's Mill Road to the confluence with the Creek, as the River flows through the Roy C. Blackwell Forest Preserve.

1.2.3 Nature and Extent of Contaminants

The contaminants of concern at the Sites are residuals – predominantly fine particles and tailings – from the historic processing of thorium-containing monazite ores at the REF, including radionuclides in the thorium decay chain and elemental metals associated with the thorium-containing ores. These contaminants are present in the soils and sediments in and along the River and Creek. While metals have been detected at the Sites, these are present to a lesser extent than the radioactive residuals and tend to be co-located; therefore, a remedy that targets the radioactive materials would address the other contaminants as well.

A number of investigations designed to characterize the Sites – including gamma walkover surveys and soil boring installations – have been conducted since 1976 by NRC, USEPA and Kerr-McGee. The most extensive investigations were conducted by Kerr-McGee starting in 1997. First, surface scans were carried out to identify areas exhibiting greater than 7.2 picoCuries per gram (pCi/g) total radium on the surface of soils/sediments. This level represents 5.0 pCi/g above background, with background determined by USEPA to be 2.2 pCi/g. In areas exhibiting greater than 7.2 pCi/g, down hole borings were advanced to delineate the vertical and horizontal extent of materials exceeding 7.2 pCi/g total radium. This delineation drilling program involved more than 15,000 borings. Results are presented on Figures 3-2A through 3-2C of the RI Report (BBL, 2004). The investigations are described in Section 3 of the RI Report, while the nature and extent of contamination at the Sites is presented in Section 4 of the RI Report (BBL, 2004) and summarized below.

The results of these investigations indicate that radioactivity levels of thorium residuals detected at the Sites are above levels measured in background areas. Background radioactivity has been quantified in terms of exposure levels and radionuclide radioactivity in soils and groundwater. Thorium-232 (Th-232) and uranium-238 (U-238) are natural radioactive components of the earth's crust. Th-232 decays to produce radium-228 (Ra-228), whereas U-238 decays to produce Ra-226 (see Figures 1-2 and 1-3). Ra-226 and Ra-228 radioactivity levels are combined to quantify results in total radium equivalents (RE). Total RE is used to express radioactivity levels in the soil.

The highest radioactivity at the Sites is in the soils and sediments in and along Kress Creek, particularly in the area of Gunness Lake, but decreases with distance downstream to the confluence with the West Branch DuPage River. The radioactivity levels detected throughout the West Branch DuPage River – which are highest in the soils and sediments of the STP Site and decrease with distance downstream to and below the confluence – are lower overall than in Kress Creek. In the contaminated floodplain soils of the Sites, the higher radioactivity levels are generally present in the proximal (near the channel) floodplain, decreasing with distance out into the distal (away from the channel) portions.

Information gathered during the investigations also revealed that in areas of the Sites, a layer of overburden is present on top of the contaminated soils and sediments. While the thickness of the overburden varies, it is between 0.3 and 1.2 feet on average, with the thickest layer (2.8 feet average) in the impounded area behind McDowell Dam. At 2.3 feet (average), the contaminated layer is thickest in the sediments in the impounded area behind Warrenville Dam, compared to an average thickness of 1.1 to 1.4 feet in the rest of the Sites.

Kerr-McGee is performing additional characterization (i.e., surface scanning and if necessary, subsurface delineation) in specific areas of the Sites, including the stretch of the River between the Warrenville and McDowell Dams. The findings from this future characterization could modify the extent of materials targeted for remediation at the Sites however, it is not anticipated that they would affect the selection of a remedial alternative. Any modification to the extent of targeted material would be considered, as appropriate, during the detailed design of the selected remedial alternative.

1.2.4 Contaminant Fate and Transport

The active mechanisms of fate and transport that impact the levels of radioactive residuals in the sediments and floodplain soils of the Sites are primarily physical processes. The radioactive materials at the Sites do not volatilize or oxidize, and they do not undergo biodegradation. Radioactive decay is the only biological or radiochemical process that may impact activities, but the timeframes for half-life decay for some of the contaminants are long (half-life for thorium-232 is 14 billion years, for Ra-226 undergoing alpha decay is 1,600 years and for Ra-228 undergoing beta decay is 5.7 years [see Figures 1-2 and 1-3]). As a result, the radioactive residuals are expected to persist in soils and sediments, and the fate and transport focus at the Sites is on the mechanisms that influence their mobility.

Solids transport is the primary fate and transport mechanism that affects the migration of thorium residuals at the Sites. The residuals are present as fine-grained materials that were released from the storm sewer that passes under the REF and/or scoured from the sediment bed and the Creek/River banks during high flow events. The fine particles were generally deposited in downstream floodplain areas (if the flow was high enough to overtop the banks) or settled out in quiescent areas of the River and Creek – particularly in the impounded areas behind McDowell and Warrenville Dams – and along the inside of river bends. The result of this mechanism of fate and transport is clear in the assessment of nature and extent. The locations of radiological residuals with radioactivity above 7.2 pCi/g are primarily within the depositional areas, and are largely absent in the faster-flowing reaches.

Both the River and Creek are net depositional environments (i.e., the annual rate of deposition exceeds the erosion rate); therefore, sediments tend to accumulate over time, particularly in the reaches where water flow is slow. The overburden layer that is present on top of the contaminated sediments and floodplain soils is the result of the deposition process. Overtopping of the banks of the River and Creek during periods of high flow is the primary mechanism of transport to the floodplain for both contaminated materials and overburden. Since deposition is a continuous, ongoing process in the River and Creek (compared to the sporadic inundation of the floodplain), the layers of contaminated materials and overburden in the River/Creek are generally thicker than the layers in the floodplain. Higher radioactivity levels have been detected in the proximal (near the channel) floodplain as compared to distal (away from the channel) areas since the proximal area is flooded more frequently.

The findings on nature and extent summarized in Section 1.2.3, in conjunction with the understanding of the mechanisms of fate and transport active at the Sites were used to develop the conceptual site model presented in Section 6 of the RI Report (BBL, 2004). The conceptual site model incorporates the following:

- The primary contaminants of concern at the Sites are thorium residuals – predominantly fine particles and tailings - from the historic processing of thorium-containing monazite ores at the REF, including radionuclides in the thorium decay chain and elemental metals associated with the thorium-containing ores;
- The highest sediment/soil radioactivity levels were detected in Kress Creek, with radioactivity levels decreasing in the downstream portion of the West Branch DuPage River (downstream of the Kress Creek confluence);

- The higher radioactivity levels in floodplain soils were predominantly present in the proximal (near the channel) floodplain as compared to the distal (away from the channel) portions of the floodplain;
- The radiological contaminants are associated with monazite ores and are distributed in the environment along with other fine-grained materials;
- The presence of an overburden layer on top of contaminated soils and sediments in areas of the Sites indicates the ongoing burial of radiological contaminants; and
- The primary contaminant transport mechanism is solids transport via surface water with subsequent downstream deposition either in quiescent areas of the Creek or River (e.g., behind the Warrenville and McDowell Dams), or in overbank floodplain areas during high flow events.

The conceptual site model will be used to focus the development of the potential remedial alternatives.

1.3 Baseline Risk Assessments

USEPA has conducted a human health and ecological risk assessment for the Sites to evaluate the risk associated with the contaminants at the Sites and to document the basis for considering and conducting remedial actions for the Sites. These documents are incorporated herein by reference.

2. Development of Remedial Action Objectives and General Response Actions

2.1 Introduction

This section presents the Remedial Action Objectives (RAOs) for the Sites, provides a listing of the applicable or relevant and appropriate requirements (ARARs), identifies General Response Actions (GRAs) for use in the development of potential remedial alternatives, and defines volumes and areas subject to remediation.

RAOs are site-specific goals developed to address potential human health and ecological risks, and form the basis for comparing the effectiveness of the various potential remedial alternatives. A listing of the RAOs is presented in Section 2.2.

ARARs are federal and state standards, requirements, criteria, or limitations that are either legally applicable, or relevant and appropriate for use at the Sites, and must be considered in the development and evaluation of the specific remedial actions. Compliance with ARARs is one of the nine criteria considered under CERCLA in the evaluation of potential remedial alternatives (Sections 4 and 5). A listing of potential ARARs for the Sites is provided on Tables 2-1 through 2-3.

GRAs represent general categories of the types of remedial actions that may be considered to achieve the RAOs and comply with ARARs. The GRAs for the Sites are presented in Section 2.4. Section 2.5 includes an estimate of the volumes and areas of the Sites potentially subject to remediation.

2.2 Remedial Action Objectives

As stated in USEPA guidance (USEPA, October 1988), RAOs are developed as medium-specific goals or objectives for the protection of human health and the environment. RAOs for the Kress Creek and STP Sites are based on ARARs, experience at the REF and other Kerr-McGee NPL Sites, and goals specific to the Sites. RAOs for the Sites are as follows:

1. Reduce risks to human health and the environment presented by sediments and floodplain soils containing elevated levels of total radium by reducing soil concentrations to levels that are consistent with the requirements outlined in 40 CFR Part 192 (the regulations implementing UMTRCA) and Illinois Source Material Milling Regulations; and

2. Mitigate, to the extent practicable, potential adverse effects to the environment as a result of implementation of remedial activities at the Sites.

The focus of remedial efforts will be to minimize exposure to contaminated sediment and floodplain soils within the Sites. Therefore, the primary RAO (RAO #1) will be to address sediments and floodplain soils containing elevated levels of total radium consistent with 40 CFR Part 192 (the regulations implementing UMTRCA) and Illinois Source Material Milling Regulations to reduce potential risk at the Sites.

The objective of the RAO #2 is to mitigate impacts the implementation of the various remedial alternatives could have on the environment. These potential impacts may be minimized through the use of appropriate engineering controls. Potential impacts associated with remedial activities should be mitigated to maintain wetlands and forest preserve areas and impacts that cannot be avoided could be addressed through restoration activities.

2.3 Identification of ARARs and TBCs

According to USEPA guidance (USEPA, October 1988), remedial actions must comply with applicable or relevant and appropriate requirements of Federal and State standards, requirements, criteria, or limitations. State ARARs take precedence if they are more stringent than the associated Federal requirements (USEPA, October 1988). In addition to ARARs, guidance materials that have not been promulgated or regulatory standards that are not applicable or relevant and appropriate may be considered (including local/County requirements); these are referred to as items "to be considered" (TBC). While TBCs may be considered along with ARARs, they are not legally binding and do not have the status of ARARs.

The ARARs and TBCs identified for the Sites are categorized into three types: 1) chemical-specific; 2) action-specific; and 3) location-specific. The chemical-specific ARARs establish the acceptable amounts or concentrations of a chemical that may be found in, or discharged to, the ambient environment. Action-specific ARARs are technology- or activity-based performance or design requirements associated with the potential remedial activities being considered for the Sites. Location-specific ARARs establish requirements that protect environmentally-sensitive areas and other areas of special interest.

A list of potential ARARs and TBCs identified for the Sites is presented in Tables 2-1 through 2-3. In addition to Federal and State ARARs and TBCs, these tables also contain TBCs specific to DuPage County (in which the Sites are located). The application of the ARARs in the evaluation of the potential remedial alternatives is discussed further in Sections 4 and 5 of this document.

2.4 General Response Actions

To support the development of potential remedial alternatives used to achieve the RAOs described in Section 2.2, a number of General Response Actions (GRAs) were identified. GRAs typically are medium-specific technology types that may be used to satisfy one or more of the RAOs. For the Sites, the GRAs are grouped into nine broad categories. These categories are intended to be applicable to both sediment and floodplain soils at the Sites.

1. <u>No Action</u>: Evaluation of the no action approach is required as part of the CERCLA process.

2. <u>Monitoring/Institutional Controls:</u> A monitoring program would be developed and implemented to track future site conditions and/or conditions during remediation as appropriate. Institutional controls include access/deed restrictions to reduce contact with contaminated media within the Sites.

3. <u>Source Control/Natural Recovery</u>: Includes reduction or elimination of contaminant sources and consideration of natural processes (e.g., radiochemical decay, burial, scour, and redistribution of sediments and floodplain soils) ongoing at the Sites.

4. <u>In-Place Containment</u>: Includes technologies such as capping/covering to isolate contaminants contained in the sediment and floodplain soils.

5. Sediment/Soil Treatment: Includes both in-situ and ex-situ treatment (e.g., immobilization, and/or other potentially appropriate treatment technologies) to reduce contaminant levels and/or movement.

6. Sediment/Soil Removal: Includes removal of materials via dredging or excavation.

7. Sediment/Soil Dewatering: Includes technologies to process removed sediment/soil to reduce the water content and facilitate disposal.

8. Sediment/Soil Disposal: Includes the use of off-site landfill or on-site confined disposal facilities to provide permanent storage of removed sediment/soil.

9. Residual Management: Includes methods for processing the water or residues that may be removed from the sediment/soil during removal, dewatering, or disposal.

These GRAs are discussed in greater detail in Section 3.3, along with the representative process options retained in each GRA category.

2.5 Volumes and Areas Potentially Subject to Remediation

As summarized in the RI Report, Kerr-McGee first conducted a surface gamma survey to identify areas where there were gamma readings greater than 7.2 pCi/g total radium. Kerr-McGee then conducted borings in areas determined to have surface gamma radiation above 7.2 pCi/g to define the vertical and horizontal extent of such materials. Materials identified through this process are referred to in this FS as “targeted materials”. This 7.2 pCi/g criterion is based upon UMTCRA and Illinois standards which USEPA and the State regulatory agencies interpret to require remedial attention to areas exceeding 5 pCi/g total radium over background.

The background concentration of total radium related to the Sites was estimated by CH2M Hill in 2002. The natural radioactivity of Th-232 in soil in the West Chicago area has been reported as ranging from approximately 0.85 pCi/g (IDNS, June 1993) to 1.6 pCi/g (Frame, February 1984). Under natural conditions, Ra-228, an alpha decay product of Th-232, is in secular equilibrium with Th-232, which translates to a background radioactivity of Ra-228 in the West Chicago area of approximately 0.85 to 1.6 pCi/g. The background radioactivity of Ra-226, a decay product of U-238, is approximately 1.4 pCi/g (Booth et al., November 1982).

CH2M Hill estimated the background radioactivity from a set of 29 samples as part of the investigation work performed at the Residential Areas Site by USEPA. The samples were composited from 0- to 6-inch grab samples collected from 60 background properties in the West Chicago area. The radioactivity measured was between 1.62 and 3.55 pCi/g, with a mean radioactivity of 2.2 pCi/g for combined Ra-228 and Ra-226 (CH2M Hill, March 2002).

Given the focus on surface gamma scans as a finding mechanism, and follow up by delineation drilling and down-hole gamma readings in more than 15,000 locations, it is believed that the characterization was sufficiently comprehensive to identify material that reasonably could pose risk to human health or the environment. Targeted materials include both sediment and floodplain soils. The areal extent of these locations is shown on Figure 2-1. In several locations, targeted materials are buried under a layer of material that does not require remediation (i.e., overburden). Accordingly, remedial alternatives have to take account of both targeted materials and associated overburden.

The extent of each potential remedial area shown on Figure 2-1 was determined based on the results of the subsurface delineation drilling program. Next, material volumes were estimated for floodplain soil and sediment within each area (both for targeted materials and overburden material), since overburden materials would have to be addressed to remediate the underlying targeted materials. Volumes were calculated for each area by multiplying the total surface area by the average depth of either targeted material or material that is overburden. Volumes were then distinguished as sediment or floodplain based on the percent of the total surface area that exists within or outside of the Creek/River boundary. A summary of these volume estimates broken out by geographic location is presented in Table 2-4. These volumes (and areal extent) of material are used as the basis of evaluations contained in this feasibility study.

Note that Kerr-McGee is performing additional characterization (i.e., surface scanning and if necessary, downhole drilling) in specific areas of the Sites, including the stretch of the River between the Warrenville and McDowell Dams. Volumes provided in this document do not take into account this future characterization, and therefore may require modification based on the results of the additional characterization work.

3. Identification and Screening of Technology Types and Process Options

3.1 Introduction

This section presents the identification and screening of technology types and process options that will be used to develop potential remedial alternatives for the Sites. In accordance with USEPA guidance (October 1988), potentially applicable remedial technologies are evaluated in two steps. As part of the initial identification and screening process step, a wide array of potentially applicable remedial technologies were evaluated based on technical implementability considering site-specific issues and conditions. Once the technology types determined to be technically implementable were selected and the associated process options identified, a second evaluation with respect to effectiveness, implementability, and relative costs was performed. The technology types and process options retained after the second step were then used to develop a set of potential remedial alternatives for the Sites. The final portion of this section includes an evaluation of the remedial alternatives considering effectiveness, implementability, and relative cost in order to identify those alternatives to be carried forward for detailed and comparative analyses (Sections 4 and 5).

3.2 Initial Identification and Screening of Technology Types and Process Options

Based upon the site-specific GRAs developed in Section 2.4, several potential technology types and process options have been compiled. According to USEPA guidance (October 1988), technology types are general categories of technologies, while technology process options are specific processes within each technology type (e.g., dredging would be a process option under the sediment removal technology type).

As discussed above, the initial screening of technologies only considers technical implementability (i.e., implementability with respect to site conditions, chemical and/or physical characteristics of site materials, feasibility, and full-scale use). Screening based on technical implementability was performed by applying general knowledge and experience gained at this and other sites, using both information available in the literature, and professional judgment.

Table 3-1 provides the results of the preliminary identification and screening of potential remedial technologies and process options that could reasonably be applied to the targeted sediments and floodplain soils along Kress Creek and the West Branch DuPage River. Specifically, Table 3-1 includes the GRAs with broad remedial technology types, associated process options with descriptions of each option, and the preliminary assessment of technical implementability. Remedial technologies and process options retained for further analysis are shaded within Table 3-1.

3.3 Evaluation of Technology Types and Selection of Representative Process Options

Those process options retained in Table 3-1 (i.e., those that are shaded) were further evaluated in Table 3-2 based on the expanded criteria of effectiveness, implementability, and relative cost. The various process options identified under a particular technology type were compared to the other processes in the same technology type. As a result, a minimum of one process option from each technology type was retained (and considered representative) for development of the preliminary remedial alternatives. Representative process options are summarized in Table 3-3. Alternatives to be evaluated in this document were then assembled from the representative process options.

It should be noted that selection of a particular process option does not eliminate other initially retained process options in a technology type from potential use; it is simply intended to streamline the development of potential remedial alternatives. A process option(s) not selected as representative still could be considered during remedial design if its technology type is part of the selected remedial alternative. It should be noted that certain remedial technology types (e.g., sediment removal, sediment dewatering) can only be used in combination with other technology types in order to form a complete remedial alternative while other technology types (e.g., no action, institutional controls) may stand alone. The screening criteria used to evaluate the process options in Table 3-2 are further described below.

Effectiveness
The effectiveness of each process option under a particular technology type was evaluated with respect to:

- Potential effectiveness of the process option in handling estimated areas and volumes of targeted media and meeting RAOs;
- Potential impacts to human health and the environment during the construction and implementation phase; and
- Reliability of the process option considering contaminants and conditions at the Sites (USEPA, October 1988).

Implementability
Implementability includes consideration of both the technical and administrative feasibility of implementing a technology process (USEPA, October 1988). As described under Section 3.2, technical implementability was used in the initial screening of technology and process options. Therefore, in the second step of the evaluation process, the following institutional aspects of implementability were considered:

- Ability to obtain necessary permits/approvals for offsite actions;
- Availability of treatment, storage, and disposal services; and
- Availability of necessary equipment and skilled workers to implement the technology (USEPA, October 1988).

Cost
Relative costs (i.e., high, moderate, or low) were identified in order to perform a comparative evaluation of process options under each technology type. The relative cost comparison is used at this point in the feasibility study process because detailed cost comparisons cannot be made until complete alternatives are developed.

Table 3-2 details the evaluation of technology types and process options retained after the first screening in terms of effectiveness, implementability, and cost. A summary of the results of the second screening step, including the basis of selection for each representative process option within each GRA/technology type, is presented below. Representative process options are also summarized on Table 3-3. Assembly and screening of the potential remedial alternatives for the Sites is provided in Sections 3.4 and 3.5.

3.3.1 No Action

No action does not include any active remedial measures, monitoring, or other controls beyond the activities and efforts already performed at the Sites. This GRA has been retained as a representative process option as required by the NCP, and will be used as a baseline against which the other alternatives will be evaluated. The primary remediation mechanism of this alternative includes ongoing natural attenuation processes to isolate contaminants from contact and reduce the quantity of contaminated materials.

3.3.2 Monitoring and Institutional Controls

Site-wide monitoring was retained as a representative process option under this GRA. Monitoring would include the collection and analysis of samples and recording of field observations to provide a mechanism with which to track natural recovery processes at the Sites. Monitoring could also be used in combination with any active remedial action measures performed at the Sites to determine effectiveness of the remedial action.

Access and deed restrictions were retained as representative process options under the institutional controls GRA. These process options would likely be necessary as part of any alternative that would leave targeted material on site. It should be noted however, that limiting access and enforcing deed restrictions in the Creek/River portion of the Sites may be difficult. Limiting access and enforcing deed restrictions in floodplain targeted areas may also be difficult because the areas include private homeowners and public forest preserves/parks.

3.3.3 Source Control/Natural Recovery

Source control and natural recovery were retained as representative process options under this GRA. Source control activities have been substantially completed at the Sites. For the Upland STP, the previous removal actions and removal actions as part of the October 16, 2003 AOC should complete the source control activities for this site. Additionally, completion of decommissioning activities at the REF and closure of the REF should also complete the source control activities for the Kress Creek Site.

Natural recovery processes are ongoing in the Creek/River and on land areas. These natural processes include physical (e.g., sedimentation, dilution), and radiochemical processes (e.g., stabilization, decay). These processes have also been retained as a representative process option. It should be noted however, that any reduction of risk through natural radiochemical processes would be expected to require a long time period.

3.3.4 In-Place Containment

The representative process option retained under this GRA was engineered capping. Engineered capping involves placement of a cap consisting of single or multiple layers of clean materials (e.g., sand, gravel, cobbles) over in-situ sediment or soil to supplement the existing overburden and provide additional isolation from contaminated materials. The addition of an armor layer (i.e., cobbles) could be added to enhance the cap's ability to resist erosional forces or to provide specific substrate for benthic invertebrates or other fauna. A geotextile could also be used as a filter and separation layer. The engineered cap would be designed in consideration of USEPA and USACE guidance documents.

3.3.5 Sediment/Soil Treatment

Several different types of sediment/soil treatment were evaluated under this GRA and can be grouped into three technology types – immobilization (ex-situ stabilization/solidification), extraction in-situ (soil flushing), and extraction ex-situ (physical separation). Each of these technology types would need to be implemented with other technology types (i.e., removal, dewatering, disposal, etc.) to achieve the RAOs. The representative process option retained under this GRA was ex-situ stabilization/solidification.

Treatment technologies have not been demonstrated to be effective for in-situ sediment, and their overall effectiveness for in-situ soils can be significantly reduced depending on the soil types and the presence of debris or other objects within the soil layers. Physical separation, which separates contaminated and clean materials through the use of sensitive radiation detectors, could be effective for the Sites, however the system has limitations, including the type of radioactivity screened, and the soil/sediment entering the system must meet certain moisture content and particle size requirements. In general, the availability of specialized equipment and personnel involved with many treatment technologies is limited and more costly than other technology types within this GRA.

Since it is likely that removed sediment/soil will need to be disposed, treatment to address free water in the removed materials may become necessary to meet licensed disposal facility requirements. In order to meet this potential requirement, ex-situ stabilization/solidification will be retained as the representative process option under treatment.

3.3.6 Sediment/Soil Removal

Two removal processes were retained under this GRA – mechanical dredging and mechanical excavation in-the-dry. Mechanical dredges are widely available for sediment removal projects and have been used extensively in both navigation and environmental dredging projects. One of the most common mechanical dredge types is the clamshell, which can be fitted with a seal for environmental applications. Mechanical dredges use force to dislodge and excavate sediment, can operate in areas with limited space, and are highly maneuverable. These dredges are able to remove large debris and rocks, and reduce the water content of the targeted material. For environmental applications, dredging production rates are lower than that of other dredge types (i.e., hydraulic dredging) and there is a greater potential for resuspension and spillage during removal activities and unloading. As a result, monitoring activities would likely be required during dredging to assess impacts to the surrounding environment.

Mechanical excavation in-the-dry has been also retained for sediment and soil removal activities. As used throughout this report "in-the-dry" means only that measures are taken to isolate excavation areas and to pump excess water from these excavation areas as needed. Mechanical excavation in-the-dry has been retained since dredging is not feasible for targeted upland soil removal areas. This removal process involves the use of an excavator (or similar equipment) to directly remove soils or sediments from targeted areas and place materials into trucks for transport to the processing or disposal area. This method can also be used for near shore or shallow water areas within the Creek/River. Structures such as sheet piling or Jersey barriers can be placed in the Creek/River to divert water flow, and pumps can then be installed to dewater an isolated section to allow for relatively dry removal activities.

3.3.7 Sediment/Soil Dewatering

The representative process option retained for this GRA is gravity drainage. Gravity drainage involves stockpiling the sediment/soils and allowing the excess water to drain via gravity into an area where it is collected and then pumped away for treatment. Gravity drainage requires a staging area with adequate room for stockpiling materials. The final decision regarding the most appropriate sediment/soil dewatering method will be made during the design phase.

3.3.8 Sediment/Soil Disposal

Disposal in an existing off-site licensed disposal facility was selected as the representative process option for the GRA. Dewatering (and potentially stabilization) will likely be required prior to disposal.

3.3.9 Residuals Management

The only residuals potentially requiring management will be generated from sediment/soil removal activities. Filtration was retained as the representative process option for water treatment. Water would be filtered through various media (e.g., sand) to remove contaminated particles from the water train. Filtration is commonly used for water treatment processes.

3.4 Assembly of Potential Remedial Alternatives

The GRAs/technology types and representative process options (summarized on Table 3-3) retained following the two-step screening process were combined to develop three potential remedial alternatives for the Sites. An appropriate number of representative process options were included in each potential alternative so that the alternative describes the complete remediation effort that will be necessary to meet the identified RAOs. The assembled potential remedial alternatives are briefly described below.

Alternative #1 – No Action

The no action alternative is required as part of the NCP process to provide a baseline for comparison for other potential alternatives. The no action alternative includes no active remediation or monitoring of the ongoing natural recovery processes within the areas targeted for remediation at the Sites.

Alternative #2 – Monitored Natural Recovery

This alternative would include recovery of the Sites through natural processes as a means of reducing risk at the Sites. Given the time frame associated with the radiochemical decay process for thorium and the expected rate of deposition in the floodplain, it is expected that natural recovery through physical processes (i.e., sedimentation) would be most effective for the sediment areas. Although they would be most effective for sediment, the advancement of natural recovery processes throughout the Sites (floodplain and sediment) would be tracked through monitoring. Alternative 2 includes the following representative process options: site-wide monitoring and institutional controls; source control; and natural processes.

Alternative #3 – Excavation and Off-Site Disposal of Targeted Sediment/Soil throughout the Sites

This alternative would include mechanical removal through dredging and/or excavation in-the-dry for targeted sediments/soils identified in Section 2.5. Alternative 3 is comprised of the following representative process options: site-wide monitoring; source control; ex-situ stabilization/solidification; mechanical dredging; mechanical excavation; gravity drainage; filtration and off-site disposal.

Removed materials would be allowed to dewater through gravity drainage, with the excess water collected and filtered. Ex-situ stabilization/solidification would be used if necessary to treat removed materials in preparation for off-site disposal in a licensed disposal facility. The effects of source control activities would be ongoing at the Sites. Monitoring activities would be performed during remedial activities to assess any implementation effects from remedial action, and after remediation as appropriate to evaluate effectiveness.

Alternative #4 – Capping of Targeted Sediment/Soil throughout the Sites

This alternative would provide for the placement of an engineered cap over targeted sediment/soils identified in Section 2.5. The engineered cap would be designed according to USEPA and USACE guidance, and would be implemented so as to not reduce flood conveyance (i.e., excavation of overburden or contaminated material equal to the depth of the cap would occur as necessary prior to cap placement). This alternative requires some degree of excavation; therefore Alternative 4 is comprised of the same representative process options as Alternative 3 plus access and deed restrictions, natural recovery processes, and engineered capping. Access and deed restrictions would be required under this alternative in order to maintain cap/cover integrity. Monitoring would be performed during remedial activities to assess implementation effects from remedial action, and after remediation as appropriate to evaluate effectiveness.

3.5 Alternatives Screening Process

Once potential alternatives have been assembled from the retained GRAs/technology types and representative process options, each alternative is evaluated against the broad criteria of short- and long-term effectiveness, implementability and cost. The retained potential alternatives are carried forward into the detailed and comparative analyses (Sections 4 and 5). This broad screening process is typically undertaken to reduce the number of alternatives that will undergo a more thorough and extensive analysis (USEPA, October 1988). Comparisons during this screening step are usually made among similar alternatives whereas comparisons during the detailed and comparative analyses (Sections 4 and 5) will differentiate across the entire range of alternatives (USEPA, October 1988). All four alternatives developed for the Sites (*Alternative #1 – No Action*, *Alternative #2 – Monitored Natural Recovery*, *Alternative #3 – Excavation and Off-Site Disposal of Targeted Sediment/Soil throughout the Sites*, and *Alternative #4 – Capping of Targeted Sediment/Soil throughout the Sites*) contain varied technology types and representative process options and are a manageable number to carry through the detailed and comparative analyses, therefore all four will be retained.

4. Detailed Evaluation of Remedial Alternatives

4.1 Introduction

This section presents the detailed analysis of each retained alternative developed from the representative technologies and process options provided in Section 3. In accordance with the NCP, each alternative is assessed against seven of the nine evaluation criteria described in Section 4.2. The results of this detailed evaluation will then be used in Section 5 to perform a comparative analysis of alternatives relative to the evaluation criteria.

The detailed evaluation of remedial alternatives consists of a description of each alternative followed by an assessment relative to each individual NCP evaluation criterion. Preliminary cost estimates are provided as part of the detailed evaluation. Note that while some details on equipment, processes, etc. are provided in the alternative descriptions, modifications and refinements will be necessary during the design phase.

4.2 Evaluation Criteria

Nine evaluation criteria (two threshold, five balancing, and two modifying) have been established by USEPA to address the overall CERCLA and NCP requirements. These evaluation criteria serve as the basis for conducting the detailed analysis during the FS process and for subsequently selecting an appropriate remedial action (USEPA, October 1988). The nine evaluation criteria are as follows:

- **Overall Protection of Human Health and the Environment:** Addresses an alternative's overall ability to provide adequate protection of human health and the environment through eliminating, reducing, or controlling potential exposure. The RAOs for the Sites are goals or objectives for protection of human health and the environment. Thus, the potential for each alternative to achieve the RAOs (identified in Section 2.2) is considered.

- **Compliance with ARARs:** Assesses whether the alternative will meet the identified chemical-specific, location-specific, and action-specific ARARs (identified in Section 2.3).

- **Long-Term Effectiveness and Permanence:** Evaluates the effectiveness of a given alternative in terms of reducing exposure and potential risk, and the ability to maintain protectiveness over time. Factors to be considered, as appropriate, include the magnitude of residual risk remaining following completion of remedial activities and the adequacy and reliability of controls.

- **Reduction of Toxicity, Mobility, or Volume through Treatment:** Considers the degree to which an alternative reduces the toxicity, mobility, or volume of contaminated materials through treatment.

- **Short-Term Effectiveness:** Assesses the effects to human health and the environment related to construction and implementation of each alternative. Specific considerations include protection of the community and workers during remedial activities, environmental impacts associated with the remedial action, effectiveness of mitigation measures during construction, and time until RAOs are achieved.

- **Implementability:** Addresses the technical and administrative feasibility of implementing an alternative, and the availability of various services and materials required during implementation. Technical feasibility includes the ability to construct and operate the technology, reliability of the technology, ease of undertaking additional remedial action, and monitoring the effectiveness of the technology. Administrative feasibility includes coordination with other offices and agencies to obtain necessary permits, access, and approvals.

- **Cost:** Evaluates the present-worth, direct and indirect capital, operating, and maintenance costs of implementing an alternative.

- **State (Support Agency) Acceptance:** Assesses the technical and administrative issues and concerns that supporting agencies may have regarding each of the alternatives. This criterion will be addressed in the ROD once comments on the proposed plan have been received.

- **Community Acceptance:** Evaluates the issues and concerns the public may have. Similar to State (Support Agency) Acceptance, this criterion will be addressed in the ROD once comments on the proposed plan have been received.

The following subsections contain a detailed evaluation of the following potential remedial alternatives (as developed in Section 3.5):

- o Alternative 1: No Action;
- o Alternative 2: Monitored Natural Recovery;
- o Alternative 3: Excavation and Off-Site Disposal of Targeted Sediment/Soil throughout the Sites; and
- o Alternative 4: Capping of Targeted Sediment/Soil throughout the Sites.

4.3 Detailed Evaluation of Alternatives

4.3.1 Alternative 1 – No Action

4.3.1.1 Description (Alternative 1)

Under this alternative, no active remediation would occur at the Sites. Further, no monitoring would be conducted to assess overall condition of the Sites over time. Naturally occurring processes (e.g., half-life decay, erosion, and sedimentation) would occur on their own over time to reduce radioactivity levels or isolate contaminated materials within the sediment and soil. Note that evaluation of the no action alternative is a requirement of the NCP and will serve as a baseline against which the other potential remedial alternatives are evaluated.

4.3.1.2 Overall Protection of Human Health and the Environment (Alternative 1)

For Alternative 1, overall protection of human health and the environment may eventually be achieved as natural recovery processes reduce radioactivity of total radium in sediment and floodplain soils. Reductions in radioactivity throughout the Sites would occur over a long time period through half-life decay (see Figures 1-2 and 1-3). Erosion and re-deposition would reduce radioactivity levels in sediments across the Sites, and sedimentation in the Creek/River and/or deposition in the floodplain soils throughout the Sites would provide added protection through the addition of clean materials as a “cover” over areas subject to potential remediation.

These physical processes (erosion/re-deposition and sedimentation/deposition) would likely be most effective in reducing risks as they occur in sediment areas. A monitoring program would not be implemented to track the reductions in radioactivity levels and decreased potential for exposure at the Sites.

This alternative may eventually meet the primary RAO (RAO #1 – reduction of risks to human health and the environment) through the naturally occurring processes described above; however it would take a long period of time until protection is achieved and no monitoring would be conducted to track progress. RAO #2, mitigation of potential adverse effects to the environment as a result of implementation of remedial activities, would be satisfied immediately as no intrusive remedial activities would be performed at the Sites. Impacts to wetlands, forest preserve areas, and established trees would be completely avoided. In consideration of RAO #2, any conditions attributable to the presence of contaminated materials would continue for a protracted time period, as half-life decay and sedimentation are both slow processes and no active remediation would take place.

4.3.1.3 Compliance with ARARs (Alternative 1)

Since no active remedial efforts are proposed under Alternative 1, action-specific and location-specific ARARs do not apply. Although chemical-specific ARARs may eventually be achieved through half-life decay, erosion, and sedimentation, materials targeted for potential remediation (consistent with UMTRCA, 40 CFR Part 192 and Illinois Source Material Milling Regulations), would not be monitored to track levels.

4.3.1.4 Long-Term Effectiveness and Permanence (Alternative 1)

Effectiveness is directly related to the degree of risk reduction attained through implementation of an alternative over time. The long-term risk reduction attained through implementation of Alternative 1 would be achieved through the naturally occurring processes of half-life decay, erosion, and sedimentation (which would reduce radiological activity levels through erosion/re-deposition and provide additional layers of clean material to isolate contaminated materials throughout the Sites). Monitoring is not proposed as part of Alternative 1, therefore the effectiveness of the naturally occurring processes would not be tracked or evaluated over time. Furthermore, no controls would be in place to limit potential future exposure at the Sites.

4.3.1.5 Reduction of Toxicity, Mobility, or Volume through Treatment (Alternative 1)

Alternative 1 does not include any active treatment and therefore would not result in any reduction in toxicity, mobility, or volume through treatment. However, half-life decay would eventually result in a reduction in total radioactivity in the sediment and soils within the Sites, thus reducing both the volume and toxicity of contaminated materials. Further, mobility of contaminated materials would be somewhat limited through sedimentation as deposition of clean materials over contaminated areas is expected to isolate those soils and sediments and reduce the potential for exposure.

4.3.1.6 Short-Term Effectiveness (Alternative 1)

Since there are no active remedial activities proposed under Alternative 1, there are no short-term effects to human health and the environment associated with implementation of this alternative.

4.3.1.7 Implementability (Alternative 1)

There are no technical implementability issues related to Alternative 1, as no action would be taken at the Sites. Further, no specific services, materials, or permits would be required.

4.3.1.8 Cost (Alternative 1)

There are no direct or indirect costs associated with implementation of Alternative 1.

4.3.2 Alternative 2 – Monitored Natural Recovery

4.3.2.1 Description (Alternative 2)

This alternative would include recovery of the Sites through natural processes as a means of reducing risk at the Sites. Given the time frame associated with the radiochemical decay process for radium and the expected rate of deposition in the floodplain, it is expected that natural recovery through physical processes (i.e., erosion/re-deposition and sedimentation/deposition) would be most effective for the sediment areas. However, the advancement of natural recovery processes throughout the Sites (floodplain and sediment) would be tracked through monitoring. Since contaminated materials would remain in place, future restrictions on land use (access/deed restriction) would be necessary.

4.3.2.2 Overall Protection of Human Health and the Environment (Alternative 2)

For Alternative 2, overall protection of human health and the environment would eventually be achieved as natural recovery processes reduce radioactivity of total radium in sediment and floodplain soils. Reductions in radioactivity throughout the Sites through half-life decay would occur over a long time period (see Figures 1-2 and 1-3). Erosion and re-deposition would reduce radioactivity levels in sediments across the Sites, and sedimentation in the Creek/River and/or deposition in the floodplain soils throughout the Sites would provide added protection in a shorter time frame through the addition of clean materials as a "cover" over areas subject to potential remediation. These physical processes (erosion/re-deposition and sedimentation/deposition) would likely be most effective in sediment areas. A monitoring program would be implemented to track the reductions in radioactivity levels and decreased potential for exposure at the Sites.

This alternative would eventually meet the primary RAO (RAO #1 – reduction of risks to human health and the environment) through the naturally occurring process provided above; however it would take a long time until protection is achieved. RAO #2, mitigation of potential adverse effects to the environment as a result of implementation of remedial activities, would be satisfied immediately as no intrusive remedial activities would be performed at the Sites. Impacts to wetlands, forest preserve areas, and established trees would be avoided completely. In consideration of RAO #2, any conditions attributable to the presence of contaminated materials would continue for a protracted time period, as half-life decay is a slow process and no active remediation would take place.

4.3.2.3 Compliance with ARARs (Alternative 2)

Chemical-specific ARARs would eventually be achieved as natural recovery processes reduce radioactivity of total radium in sediment and floodplain soils. A monitoring program would be implemented to track the reductions in radioactivity levels and progress toward meeting chemical-specific ARARs (consistent with UMTRCA, 40 CFR Part 192 and Illinois Source Material Milling Regulations). Considering action-specific ARARs, since this alternative includes monitoring activities, any work conducted on-site would be performed in compliance with the substantive requirements of applicable permits. Since no remedial activities would be implemented as part of this alternative, no location-specific ARARs would be invoked.

4.3.2.4 Long-Term Effectiveness and Permanence (Alternative 2)

Effectiveness is directly related to the degree of risk reduction attained through implementation of an alternative over time. The long-term risk reduction attained through implementation of Alternative 2 would be achieved through the naturally occurring processes of half-life decay, erosion, and sedimentation (which would reduce radioactivity levels through erosion/re-deposition and provide additional layers of clean material to isolate contaminated materials throughout the Sites). The effectiveness of the naturally occurring processes would be tracked over time through monitoring. Since contaminated materials would remain in place, future restrictions on land use (access/deed restriction) would be necessary to limit potential future exposure at the Sites.

4.3.2.5 Reduction of Toxicity, Mobility, or Volume through Treatment (Alternative 2)

Alternative 2 does not include any active treatment and therefore would not result in any reduction in toxicity, mobility, or volume through treatment. However, half-life decay would eventually result in a reduction in total radioactivity in the sediment and soils within the Sites, thus reducing both the volume and toxicity of contaminated materials. Further, mobility of contaminated materials would be limited through sedimentation as deposition of clean materials over contaminated areas would isolate those soils and sediments and reduce the potential for exposure. These reductions would be tracked over time through monitoring.

4.3.2.6 Short-Term Effectiveness (Alternative 2)

Since there are no active remedial activities proposed under Alternative 2, there are no short-term effects to human health and the environment associated with implementation of this alternative. Potential risks to workers engaged in monitoring activities would be managed through the implementation of a site-specific Health and Safety Plan (HASP).

4.3.2.7 Implementability (Alternative 2)

There are no technical implementability issues related to Alternative 2, as personnel and equipment necessary to perform monitoring are readily available. Since contaminated materials would remain in place, future restrictions on land use (access/deed restriction) would be necessary. This could pose administrative implementability issues.

4.3.2.8 Cost (Alternative 2)

The estimated present worth of this alternative is $0.4 million (M) including $0.35 M for the Kress Creek Site and $0.05 M for the STP Site. This estimate is based on a 30-year monitoring program to assess overall conditions via Sites-wide surface scanning every 5 years focusing on targeted areas similar to that performed to define the current areas, using a discount rate of 7% for all present worth calculations (USEPA, July 2000). The total estimated cost is provided in 2004 dollars. The detailed cost estimate is provided in Table 4-1.

4.3.3 Alternative 3 – Excavation and Off-Site Disposal of Targeted Sediment/Soil throughout the Sites

4.3.3.1 Description (Alternative 3)

In Alternative 3, Creek/River targeted materials (as described in Section 2.5 and shown on Figure 2-1) would be removed in-the-dry via mechanical excavation and disposed at an off-site facility. Using the methodology described in Section 2.5, it is estimated that a total of approximately 125,000 cubic yards (cy) of material would be addressed. Of this total, approximately 77,000 cy are targeted material and 48,000 cy are overburden. In areas across the Sites, targeted materials are buried under a layer of overburden material. As such, excavation and management of these overburden materials must occur as part of this alternative so that the targeted materials can be addressed. It is estimated that of approximately 125,000 cy of material addressed under this alternative, approximately 48,000 cy are overburden materials (including approximately 34,000 cy of sediment and approximately 14,000 cy of floodplain soils). A summary of estimated volumes to be addressed as part of this alternative, broken down by geographic location, is contained in Table 4-2. The volume estimates presented in Table 4-2 are sufficient for the purposes of this FS-level analysis, but would be refined during final design prior to implementation.

Prior to initiation of excavation activities at the Sites, access agreements from landowners and necessary approvals from regulatory agencies would be secured. Next, access roads, haul roads, and staging areas would be developed as appropriate to facilitate efficient implementation of this alternative. Access roads and staging areas would be sited to avoid wetlands, desirable tree species, and floodway limits to the extent practicable. Grubbing and clearing of vegetation and possible relocation of utilities may be necessary to adequately locate and develop such areas. Additionally, appropriate erosion and sedimentation controls such as geotextile fencing and earthen berms would be put in place around the staging areas prior to implementation. Access to the Sites would be appropriately restricted during excavation activities by fencing and other perimeter barriers.

It is generally assumed that targeted areas would be dewatered prior to excavation. The Sites would likely be segmented into discrete, manageable reaches so that dewatering and excavation could occur in a stepwise manner from upstream to downstream. In this way, only one segment of the Sites would be disrupted at a time. Segments would be determined based on excavation rates and the presence of logical break points in the Creek or River (based on access, morphology, or other factors).

In preparation for dewatering, silt curtains, sand bags, earthen berms, and/or sheetpiling, as appropriate may be necessary in select areas of the Sites for isolation or containment. Selection of the actual diversion or containment method would be performed during detailed remedial design. Silt curtains would be installed as appropriate downstream of excavation activities within the Creek/River to mitigate migration of suspended solids.

Dewatering each reach of both Creek/River water and groundwater from the excavation areas would be carried out using a series of bypass pumps. Sheetpile may be necessary in certain areas to stabilize slopes and further promote dewatering via flow diversion and minimization of groundwater infiltration. In select areas of the Sites, targeted remedial areas may be configured such that dewatering could occur solely through the use of sheetpile to divert flow; this scenario would be assessed during the design phase. All water would be pumped to a temporary sedimentation and erosion control area for filtering prior to discharge back to the Creek/River. In addition, dewatering sumps would be set up as necessary to assist in dewatering and maintaining manageable conditions during excavation.

Following dewatering of a segmented area, excavation of the targeted materials would proceed from upstream to downstream to address concerns regarding possible construction-related impacts to downstream areas. At each location, overburden materials would be removed first, followed by targeted material (as identified in Section 2.5). Excavation operations would be performed using an excavator and an adequate number of off-road haul trucks. It is estimated that overburden materials would be excavated at a rate of 400 cubic yards per day (cy/day). Targeted sediment and floodplain materials would be excavated at a rate of 200 cy/day and 400 cy/day, respectively.

To establish the limits of excavation of both the overburden and the targeted materials, Site survey and layout activities would be performed using a Global Positioning System (GPS). Detailed base maps would be generated to delineate two elevation horizons – one between the overburden layer and the targeted materials, and the second at the bottom of the layer of targeted materials. These horizons would then be used to establish cut depths for the excavation activities. After removing the overburden layer, the surface between the overburden and the targeted material will be surveyed using GPS techniques. Next, the layer of contaminated materials would be excavated, and the final excavation surface would be verified using GPS survey techniques to confirm that the established elevation horizon was attained. The specific GPS surveying protocols used in this process would be developed during detailed design.

After excavation, excavation materials would be hauled to a staging area. Overburden materials and targeted materials would be hauled and stockpiled separately to prevent mixing. After gravity dewatering, the overburden material would be spread out in layers no more than 12 inches thick and subject to radiological screening at appropriate intervals. A radiation safety technician would walk over the layer of overburden material with an appropriately calibrated radioactivity detector to characterize the material as either overburden or targeted material. If the material is confirmed as overburden material, it would be stockpiled in an open area adjacent to the staging area pad and be used in the excavation area as backfill. If the material is not confirmed to be overburden material, it would be moved to the section of the staging area containing contaminated material awaiting return to the REF. From there, these materials would be taken to a licensed disposal facility. Soil samples would also be collected and sent to a laboratory for confirmatory testing to verify the results of the field scanning process.

As mentioned above, materials would be hauled to the staging area and allowed to gravity dewater. The water would be collected and filtered prior to being discharged back into the Creek/River. The dewatered materials would be stabilized (if necessary) using a stabilization agent (e.g., quicklime, saw dust, cement kiln dust) to meet paint filter and moisture content requirements for disposal. (The specific stabilization agent to be used would be evaluated during detailed design.) Materials requiring off-site disposal would be taken to the REF and sent to a licensed disposal facility.

Once excavation activities are completed, floodplain areas would be backfilled to original grade so as to not alter flood water conveyance at the Sites. Sediment areas would either remain as excavated or be filled to within two feet of the original grade for purposes of stability where deep excavations may be necessary. Haul roads, access roads, and staging areas would be removed.

Restoration. Both the aquatic and terrestrial areas impacted by construction would be restored and improved (to the extent possible) after excavation activities are complete. These areas would be stabilized as necessary using bioengineering techniques, and then planted with native and/or desirable vegetation. The restoration approach would vary throughout the Sites based on location characteristics (high or low energy aquatic environment, floodplain, residential, forest preserve, etc.) and reasonable efforts would be made to restore affected areas to pre-implementation conditions. In some cases undesirable or invasive, non-native species may have been present; in those areas enhancements with native species would be planned. A restoration plan would be developed for the Sites.

Monitoring. During implementation of Alternative 3, water column monitoring would be conducted to identify, evaluate, and respond as appropriate to impacts from soil/sediment excavation and restoration activities. Water column monitoring would be performed both upstream and downstream of the excavation areas. In addition, air monitors would be established to sample for particulate matter during excavation of targeted material. Changes to work practices and/or dust control measures would be implemented as necessary. After completion of construction and restoration activities, periodic monitoring and necessary maintenance would be conducted to assess the effectiveness of stabilization measures and progress toward restoration goals for a minimum of 3 years.

Based on the assumptions outlined above, it is anticipated that Alternative 3 would take approximately 32 months to complete, including a 6-week winter shutdown period each calendar year.

4.3.3.2 Overall Protection of Human Health and the Environment (Alternative 3)

This alternative would achieve RAO #1 by reducing risks to human health and the environment through excavation of targeted materials containing elevated total radium levels (UMTRCA, 40 CFR Part 192 and Illinois Source Material Milling Regulations). Risk at the Sites is generated by the presence of targeted materials; excavation and off-site disposal of the targeted materials eliminates, to the extent practical, the potential for both proximity exposure and direct contact with these materials. Achievement of RAO #2, mitigation of potential adverse effects as a result of implementation of remedial activities, would be accomplished through use of silt curtains either alone or in combination with other containment devices such as sheetpiling, geotextile fencing, or earthen berms (depending on the containment and isolation method selected during detailed design), which would mitigate movement of solids in surface water and the effects of erosion and sedimentation during remediation. Efforts would be made to mitigate possible impacts to wetlands, forest preserve areas, and established trees; however, impacts cannot be completely eliminated and would occur, as excavation activities would be necessary in these areas. Following excavation, restoration activities would be performed such that pre-remedial conditions could likely be reestablished or enhanced.

4.3.3.3 Compliance with ARARs (Alternative 3)

The Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings (UMTRCA, 40 CFR 192) provides standard levels for radium-226 and radium-228 to be obtained as a result of remedial actions, and is a Federal chemical-specific ARAR that would be met by the successful implementation of this alternative. Similarly, the Illinois Source Material Milling Regulations describe the State chemical-specific ARAR that would be met by the successful implementation of this alternative.

Several federal, state, and local action-specific and location-specific ARARs and TBCs require that permits be obtained for activities included in this alternative. These ARARs and TBCs include the federal Clean Water Act, State Department of Nuclear Safety, Transportation of Radioactive Material regulations, Uranium and Thorium Mill Tailings Control Act, Illinois Urban Manual, Floodway Construction in Northeastern Illinois regulations, State Regulation of Construction within Floodplains, and DuPage County Countywide Stormwater and Floodplain Ordinance. However, Section 121 (e) of CERCLA states that, for response actions conducted entirely on-site, no federal, state or local permit is required. In general, on-site actions need to comply only with the substantive aspects of ARARs, not with corresponding administrative requirements (e.g., permit applications). The substantive requirements would be followed during the implementation of this alternative. Additional ARARs include OSHA requirements, which would be complied with as action-specific ARARs during implementation of this alternative.

4.3.3.4 Long-Term Effectiveness and Permanence (Alternative 3)

Implementation of Alternative 3 could be effective and reliable over the long term as a means of significantly accelerating reductions in potential human health and ecological risks at the Sites. The long-term effectiveness of Alternative 3 would result from the excavation of targeted sediments and soils containing elevated levels of total radium (UMTRCA, 40 CFR Part 192 and Illinois Source Material Milling Regulations). Permanence would be achieved as targeted materials would be removed and permanently disposed at a licensed disposal facility.

4.3.3.5 Reduction of Toxicity, Mobility, or Volume through Treatment (Alternative 3)

Alternative 3 does not include a treatment component, therefore reduction in toxicity, mobility, or volume through treatment would not be achieved. However, removal of approximately 77,000 cy of targeted material via excavation would permanently reduce the volume and mobility of contaminated materials within the Sites. During excavation activities the mobility of the contaminated materials may be increased in the short-term; however, stabilization of removed materials (i.e., through dewatering and addition of a stabilization agent) would ultimately reduce the mobility of these materials ex-situ.

4.3.3.6 Short-Term Effectiveness (Alternative 3)

The short-term effects resulting from implementation of Alternative 3 would include disruption along the Creek/River and within the floodplain to construct access areas and roads, potential impacts to the water column during excavation activities, alteration/destruction of benthic habitat and wetlands/forest preserve areas, potential disruption of recreational canoeing and land-side activities, and increased truck traffic. Truck traffic would increase substantially and persist throughout the duration of the project (approximately 32 months). This would result in an increased likelihood of accidents, noise levels, and potential for emissions of vehicle/equipment exhaust to the air. In addition, individual reaches could flood during significant rain events as portions of the Creek/River would be restricted to allow water diversion and containment around excavation areas.

During excavation activities, the potential exists for short-term releases and transport of contaminated materials from the targeted areas. In addition, excavation would likely result in re-exposure of materials with higher radioactivity levels (as compared to radioactivity levels currently present in the surface sediments or soils) that have been buried over time by sedimentation and deposition below the isolating overburden materials. These events could result in increased risks over the short term. However, engineering controls such as silt curtains and/or sheetpiling, earthen berms, etc. (depending on isolation structure selected during detailed design) and worker safety practices would mitigate releases and exposure during excavation. While silt curtains aid in the containment of suspended solids during excavation, it is not expected that the curtains would prevent all such releases in the vicinity of remedial operations. Further, the equipment required for movement/set-up of various engineering controls may disturb and suspend sediment. The impacts of any releases would be evaluated through monitoring, which would indicate the need for any preventative/mitigative measures.

The most significant impacts to wetland and terrestrial resources for this alternative would be associated with the removal of mature trees and construction of access roads along the banks of the Sites. These impacts include wetland and upland habitat destruction and habitat fragmentation. Impacts would be less significant in areas containing extensive and high quality riparian corridor habitat. Birds, mammals, reptiles, and amphibians are all likely to be impacted by the habitat disruption associated with implementation of this alternative. Benthic feeding and piscivorous species would be further impacted by the disturbance of the aquatic habitat and communities that comprise their prey base. Although the potential for these disturbances to impact wetlands, desirable tree species, and aquatic habitat does exist, restoration activities would be conducted to reestablish existing conditions, provide suitable aquatic and terrestrial habitat, and enhance areas where possible. For example, accumulated fine sediment will be removed from the impounded areas, and these areas will not be backfilled.

The length of time it would take for the benthic community to recover from the effects of implementation of Alternative 3 is unknown. The recovery time for in-stream areas would depend on the resulting substrate and stream morphology. Likewise, recovery of forested areas after road construction is likely to take decades; however, the benefit of removing non-native and undesirable species would be recognized.

In general, remediation workers and the community would not be exposed to radioactivity levels that present unacceptable health risks during excavation operations if appropriate health and safety practices (OSHA 29 CFR 1910.129) are followed through implementation of a Site-specific HASP**.**

While the duration of these short-term impacts would be approximately 32 months, completion of Alternative 3 should result in immediate achievement of remedial objectives.

4.3.3.7 Implementability (Alternative 3)

Removal has been performed for floodplain soils and sediment at a number of sites throughout the country. Dewatering followed by excavation of targeted materials at the Sites is technically feasible and could be accomplished using construction equipment available from a number of contractors. Necessary equipment and services would be available in sufficient supply to perform planned construction, restoration, and monitoring activities. Dewatering of the Creek/River is expected to be implementable in consideration of historic flows at the Sites. Once materials subject to remediation have been removed, separated, and stabilized, appropriately licensed facilities are available for disposal. Further, it is expected that materials necessary to backfill floodplain excavation areas to restore the original grade (and materials to restore grade in the Creek/River, as necessary) would be available locally in sufficient quantity.

Implementation of Alternative 3 is administratively feasible. Permits are not required for on-site activities at CERCLA sites; however, construction would be performed in accordance with the substantive requirements of Federal, State, and local regulations, and necessary approvals would be secured. Permits required for off-site activities (i.e., transport of contaminated materials to a disposal area) should be obtainable. Personnel and technology required to perform excavation are anticipated to be available in sufficient supply. Negotiations with a large number of affected landowners would be necessary to secure approvals to develop staging areas, haul roads, and access roads. While it is expected that access/approval could be secured, this process could be lengthy.

4.3.3.8 Cost (Alternative 3)

The estimated present worth of this total alternative is $73.7 M including $71.9 M for the Kress Creek Site and $1.8 M for the STP Site. This estimate is based on a 32-month construction period including a 6-week winter shutdown period each calendar year followed by a 3-year monitoring program to assess overall conditions, using a discount rate of 7% for all present worth calculations (USEPA, July 2000). The long-term monitoring/operation and maintenance program is assumed to include an annual monitoring and maintenance period for wetlands and other areas (i.e., forested uplands, low and high energy stream banks) for 3 years, and maintenance of residential/commercial areas for 1 year. The total estimated cost is provided in 2004 dollars and all capital cost expenditures are assumed to occur in 2004. The detailed cost estimate is provided in Table 4-3.

4.3.4 Alternative 4 – Capping of Targeted Sediment/Soil throughout the Sites

4.3.4.1 Description (Alternative 4)

In Alternative 4, Creek/River certain targeted materials (as identified in Section 2.5) would be isolated under an engineered cap. The engineered cap would be designed according to USEPA and USACE guidance, and overburden or targeted material would be removed to a depth equal to the thickness of the cap prior to cap placement so as not to reduce flood conveyance. For purposes of this FS, the cap thickness is assumed to be 2 feet (with an armor layer thickness of 6 inches in sediment areas). Prior to implementation of this alternative, detailed cap design would be performed.

The maximum cap thickness in the floodplain areas is assumed to be 2 feet, depending on the depth of contaminated materials. In targeted floodplain soil areas where greater than 2 feet of overburden are present, no excavation or capping would occur, as the existing overburden layer provides an appropriate degree of protection from contact or proximity risk. In targeted floodplain soil areas where the combined depth of the overburden and targeted material is less than 2 feet, mechanical excavation (as described in Alternative 3) to the bottom of the targeted material would occur and the excavation backfilled to grade. In targeted floodplain soil areas where the combined depth of the overburden and targeted material is greater than 2 feet, mechanical excavation (as described in Alternative 3) to a depth of 2 feet would be followed by placement of the engineered cap and the original grade restored. Grade changes called for in certain areas by slope stability concerns or site restoration plans may require changes to these excavation depths so that the cap placed over any remaining materials requiring remediation is a minimum of two feet thick.

Due to the greater potential for exposure to the erosive forces of running water, a 6-inch armor layer would be placed atop the 2-foot cap in sediment areas. In targeted sediment areas where greater than 2.5 feet of overburden are present, approximately 6 inches of the overburden would be removed via mechanical excavation (as described in Alternative 3) and replaced with a layer of armor stone to provide enhanced erosion resistance. In targeted sediment areas where the combined depth of the overburden and materials requiring remediation is less than 2.5 feet, mechanical excavation (as described in Alternative 3) to the bottom of the material requiring remediation would occur with no backfill. No armor layer would be placed in this instance to protect against movement of materials, since contaminated materials would be removed. In targeted sediment areas where the combined depth of the overburden and materials requiring remediation is greater than 2.5 feet, mechanical excavation (as described in Alternative 3) to a depth of 2.5 feet would be followed by the placement of 2 feet of cap material and 6 inches of armor stone.

Using the methodology described in Section 2.5, it is estimated that a total of approximately 85,000 cy of material (comprised of approximately 45,000 cy sediment and approximately 40,000 cy floodplain soil) would be removed to facilitate capping. It is estimated that of the approximately 85,000 cy of material addressed under this alternative, approximately 34,000 cy are overburden materials (including approximately 24,000 cy of sediment and approximately 10,000 cy of floodplain soils). Of the approximately 22 acres of area that would be addressed under this alternative, approximately 13 acres are located in the floodplain and approximately 9 acres are located within the Creek/River. Note that approximately 0.8 acres located within the floodplain would not be addressed due to overburden depths. A summary of volumes and areas to be addressed as part of this alternative, broken down by geographic location, is contained in Table 4-4. It should be noted that the estimates presented in Table 4-4 are sufficient for the purposes of this FS-level analysis but prior to implementation of Alternative 4, these estimates would need to be refined.

The specifications for the backfill, cap and armor stone materials would be determined during remedial design. Cap materials would be designed to contain in place any remaining materials targeted for potential remediation. These materials may consist of sands, silts, or gravel-sized particles. Armor stone to be used in targeted sediment areas would be sized based on predicted sheer stresses on the Creek/River bottom for an appropriate return frequency flow event as well as other necessary design considerations. The potential need for armor stone on targeted floodplain soil areas would also be assessed during remedial design.

Section 4.3.3.1 describes the general dewatering, materials separation, and construction procedures and overall approach that would be employed for the implementation of Alternative 4 in all reaches of the Creek and River. In instances where excavation of materials is necessary to facilitate cap placement, excavation would occur in accordance with the process outlined in Alternative 3. Cap materials would be placed using the same equipment as used to remove materials. Excavation of the targeted sediment and soil throughout the Sites would be accomplished using mechanical excavation techniques within both the Creek/River and floodplain areas. While the specific approach to excavation throughout the Sites would be determined during the remedial design phase prior to implementation, an overall approach to excavation at the Sites has been developed to facilitate the detailed evaluation of this alternative. While this approach is intended to be generally applicable, it is likely that there are specific areas within the Sites where unique adjustments and approaches would be necessary to suit the varying conditions that may be encountered at the Sites. Construction would begin with development of a series of support areas at appropriate locations along the Creek and River to provide staging areas for overburden and targeted materials to accommodate cap placement. These support areas would also be used to stage capping materials and provide access to facilitate placement of cap materials. Before placing cap materials, a comprehensive bottom/surface survey of the Sites would be performed, and identified obstacles removed, or additional cap materials would be provided to cover them in place.

The cap in the floodplain areas would generally consist of up to 2 feet (depending on the excavation depth) of materials consisting of a combination of excavated overburden, general fill and topsoil.

For purposes of this document, it is assumed that the sediment cap would include a geotextile supporting 2 feet of overburden and general fill, along with 6 inches of armoring materials such as gravels/cobbles. A geotextile would be placed as a base layer before the sand and gravel is placed in all areas of the Sites to serve as both a separation layer and provide stability. During detailed design of this alternative, design requirements would be balanced against site constraints.

Capping would be performed in one Creek or River segment at a time, starting from upstream and moving downstream, as described under Alternative 3 for excavation. Cap materials would be placed following dewatering of the area and excavation of the necessary amounts of overburden and targeted materials. Excavation and capping in one segment would be completed prior to commencing excavation/dewatering activities in downstream areas. This sequence would address concerns regarding construction-related impacts to downstream areas. Segments would be determined based on production rate and the presence of logical break points in the Creek or River (based on access, morphology, etc.). Efforts would be made to minimize disruption of River-related activities.

Cap materials would be transferred by crane either from loaded trucks or stockpiles and placed either with the use of conveyors or directly with a clamshell into the Creek or River or onto the floodplain. Cap materials are assumed to be placed at a rate of 400 cy/day.

Institutional controls to be implemented include placing restrictions on marine construction, dredging and near shore excavation throughout the Sites, and implementing deed/access restrictions for capped (and potentially other) areas of the floodplain. These efforts would be undertaken to maintain cap integrity so that the cap functions as intended.

Restoration and construction monitoring activities would be essentially the same as described for Alternative 3. After completion of construction and restoration activities, a long-term term monitoring/operation and maintenance program would be conducted that includes periodic monitoring to assess the effectiveness of stabilization measures and progress toward restoration goals for a minimum of 3 years, and surface gamma surveys of the Sites (focusing on targeted areas), bathymetry, and cap maintenance once every 5 years.

Based on the assumptions presented above, it is anticipated that implementation of this alternative would take approximately 32 months to complete, including a 6-week winter shutdown period each calendar year.

4.3.4.2 Overall Protection of Human Health and the Environment (Alternative 4)

Alternative 4 provides overall protection of human health and the environment through excavation of approximately 65% of the sediment and floodplain soils containing elevated levels of total radium (UMTRCA, 40 CFR Part 192 and Illinois Source Material Milling Regulations) and in-situ containment through capping of the remaining targeted materials. After implementation, exposure to contaminated materials at the Sites would be reduced.

Capping of the targeted sediment and floodplain soils would isolate these materials from the environment. Previous studies by the USACE, as well as experience at other capping sites, have shown that capping is effective in reducing exposure to aquatic and terrestrial organisms by isolating the sediments and floodplain soils and mitigating migration of contaminants of concern from sediments and floodplain soils to the water column.

Additionally, natural processes of sedimentation and deposition are expected to continue throughout the Sites, although they would likely be disrupted during implementation of this alternative. During implementation of Alternative 4, appropriate controls, such as the use of geotextile fencing, earthen berms, and silt curtains would be used in conjunction with a water column monitoring program to mitigate/contain the effects of construction on human health and the environment.

This alternative would achieve RAO #1 by reducing risks to human health and the environment through excavation or capping of targeted materials containing elevated total radium levels (UMTRCA, 40 CFR Part 192 and Illinois Source Material Milling Regulations). Risk at the Sites is generated by the presence of targeted materials; excavation and off-site disposal and capping of the targeted materials eliminates, to the extent practical, the potential for both proximity exposure to surface materials and direct contact with these materials. Achievement of RAO #2, mitigation of potential adverse effects as a result of implementation of remedial activities, would be achieved directly in those areas of the Sites where no excavation or capping would take place (approximately 5% of the Sites) and through use of silt curtains either alone or in combination with other containment devices such as sheetpiling, geotextile fencing, or earthen berms (depending on the containment and isolation method selected during detailed design). Use of engineering controls would mitigate movement of solids in surface water and the effects of erosion and sedimentation during remediation of those areas of the Sites where excavation and cap placement occurs. Efforts would be made to mitigate possible impacts to wetlands, forest preserve areas, and established trees; however, impacts cannot be completely avoided as excavation and capping activities would be necessary in these areas. Following excavation and capping, restoration activities would be performed such that pre-remedial conditions could likely be reestablished or enhanced. This alternative would require extensive future restrictions on land use to ensure maintenance of cap integrity.

4.3.4.3 Compliance with ARARs (Alternative 4)

The Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings (UMTRCA, 40 CFR 192) provides standard levels for radium-226 and radium-228 to be obtained as a result of remedial actions, and is a Federal chemical-specific ARAR that would not be met through the implementation of this alternative. Similarly, the Illinois Source Material Milling Regulations describes the State chemical-specific ARAR, which would also not be met. Although Alternative 4 would not achieve the quantitative level prescribed by either 40 CFR 192 or the State regulation, the Federal regulations provide certain “supplemental standards” that may be relevant and appropriate under these circumstances [40 CFR 192.21 (c)] which could be met.

Several federal, state, and local action-specific and location-specific ARARs and TBCs require that permits be obtained for activities included in this alternative. These ARARs and TBCs include the federal Clean Water Act, State Department of Nuclear Safety, Transportation of Radioactive Material regulations, Uranium and Thorium Mill Tailings Control Act, Illinois Urban Manual, Floodway Construction in Northeastern Illinois regulations, State Regulation of Construction within Floodplains, and DuPage County Countywide Stormwater and Floodplain Ordinance. However, Section 121 (e) of CERCLA states that, for response actions conducted entirely on-site, no federal, state or local permit is required. In general, on-site actions need only to comply with the substantive aspects of ARARs, not with the corresponding administrative requirements (e.g., permit applications). The substantive requirements would be followed during the implementation of this alternative. Additional ARARs include OSHA requirements, which would be complied with as action-specific ARARs during implementation of this alternative.

4.3.4.4 Long-Term Effectiveness and Permanence (Alternative 4)

Implementation of Alternative 4 could be both effective and reliable over the long term as a means of accelerating reductions in potential human health and ecological risks at the Sites. Implementation of this alternative is expected to remove approximately 65% of the targeted materials at the Sites and to isolate the balance under engineered caps. Implementation of this alternative would significantly reduce the long-term exposure and scour/transport of targeted materials in the sediments and soils throughout the Sites.

Once in place, the effectiveness and protectiveness of the caps are dependent upon implementation of a long-term maintenance and monitoring program. The long-term monitoring/operation and maintenance program is assumed to include annual monitoring and maintenance of wetlands and other areas (i.e., forested uplands, low and high energy stream banks) for 3 years, and maintenance of residential/commercial areas for 1 year. It is also assumed that surface gamma surveys of the Sites (focusing on targeted areas), bathymetry, and cap observation/maintenance would be performed once every 5 years. Adding sufficient cap/armor material to meet all relevant design criteria would require the excavation of significant quantities of overburden and targeted materials to avoid reductions of flood conveyance. Those targeted materials that are removed prior to cap placement would be permanently removed from the environment at the Sites.

The permanence of this alternative would be strongly influenced by natural processes that are expected to continue over the long term, including erosion/re-deposition as well as sedimentation/deposition of materials from areas upstream of the Sites. These sediments are expected to continue to be transported downstream and deposited in the Creek, River, and associated floodplain areas. The overburden layer present across much of the Sites provides historical evidence of these processes. The targeted materials that would be contained in-situ by the caps would continue to be susceptible to scour and erosion by forces exceeding the design criteria. Proper maintenance of the Warrenville and McDowell Dams is assumed to be conducted by the owners of those dams. Any failure or removal of those dam structures would result in a change in the hydraulic conditions in the River and could impact the ability of the cap to resist erosive forces. In addition, extensive land and water use restrictions would be necessary to ensure the long-term cap integrity.

4.3.4.5 Reduction of Toxicity, Mobility, or Volume through Treatment (Alternative 4)

Active treatment is not a component of Alternative 4; therefore, significant reduction of toxicity, mobility, or volume through treatment is not expected. Removal of approximately 65% of the targeted materials via excavation in-the-dry would permanently reduce the volume of contaminated materials within the Sites. During excavation activities the mobility of the radioactive materials may be increased in the short-term; however, stabilization of removed materials (i.e., through dewatering and addition of a stabilization agent) would ultimately reduce the mobility of these materials ex-situ. Half-life decay would continue to reduce the toxicity of the removed materials, although at an extremely slow rate. The materials left in place would be isolated under engineered caps; therefore, the mobility of these materials would be decreased. In addition, naturally occurring sedimentation and deposition would continue, providing an additional degree of mobility reduction.

4.3.4.6 Short-Term Effectiveness (Alternative 4)

The short-term effects resulting from implementation of Alternative 4 would include disruption along the Creek/River and within the floodplain to construct access areas and roads, potential impacts to the water column during excavation and capping activities, alteration/destruction of benthic habitat and wetlands/forest preserve areas, potential disruption of recreational canoeing and land-side activities, and increased truck traffic. Truck traffic to deliver capping materials and equipment would increase substantially, and persist for the duration of the project. This additional traffic would increase the likelihood of accidents, noise levels, and potential for emissions of vehicle/equipment exhaust to the air. In addition, individual reaches could flood during significant rain events as portions of the Creek/River would be restricted to allow water diversion and containment around construction areas.

Reasonable and appropriate controls (e.g., silt curtains) would be implemented to mitigate solids releases to the water column during excavation and capping activities, but these controls may not be entirely effective. For example, while silt curtains aid in containment of suspended solids during excavation and capping activities, it is not expected that the curtains would prevent all such releases in the vicinity of remedial operations. In addition, equipment required for movement/set-up of various silt curtains may disturb and suspend sediment.

During excavation and capping activities, the potential exists for short-term releases and transport of contaminated materials from the targeted areas. In addition, excavation would likely result in re-exposure of materials with higher radioactivity (as compared to radioactivity currently present in the surface sediments or soils) that have been buried over time by sedimentation and deposition below the isolating overburden materials. These events could result in increased risks over the short term. However, engineering controls such as silt curtains and/or sheetpiling, earthen berms, etc. (depending on isolation structure selected during detailed design) and worker safety practices would mitigate releases and exposure during excavation. The impacts of any releases would be evaluated through monitoring, which would indicate the need for any preventative/mitigative measures.

In general, remediation workers and the community would not be exposed to radium levels that present unacceptable health risks during excavation and capping operations if appropriate health and safety practices (OSHA 29 CFR 1910.129) are followed through implementation of a Site-specific HASP.

The most significant impacts to wetland and terrestrial resources for this alternative would be associated with the removal of mature trees and construction of access roads along the banks. These impacts include wetland and upland habitat destruction and habitat fragmentation. Impacts would be less significant in areas containing extensive and high quality riparian corridor habitat. Birds, mammals, reptiles, and amphibians are all likely to be at least temporarily impacted by the habitat disruption associated with implementation of this alternative. Benthic feeding and piscivorous species would be further impacted by the disturbance of the aquatic habitat and communities that comprise their prey base. Although the potential for these disturbances to impact wetlands, desirable tree species, and aquatic habitat does exist, restoration activities would be conducted to reestablish existing conditions, provide suitable aquatic and terrestrial habitat, and enhance areas where possible.

The length of time it would take for the benthic community to recover from the effects of implementation of Alternative 4 is unknown. The recovery time for in-stream areas where cap material is applied would depend on the resulting substrate and stream morphology. Homogenization of the stream bottom and stream morphology makes recovery of benthic organism and fish abundance and diversity unlikely. Likewise, recovery of forested areas after road construction is likely to require decades; however, the benefit of removing non-native and undesirable species would be recognized.

The duration of Alternative 4 is expected to take 32 months and the short-term impacts would last throughout implementation. The risk-based remedial objectives should be achieved upon completion of construction/restoration activities.

4.3.4.7 Implementability (Alternative 4)

The proposed sediment and floodplain soil dewatering, excavation, and capping measures would require conventional construction techniques and materials, and the necessary equipment and services are readily available. The technologies to be used in this alternative are proven, and most of the necessary materials – including all the materials necessary to construct the engineered caps – and services are available. Limited access and the presence of debris may make it difficult to place a uniform layer of cap material on some areas of the Creek or River bottom.

Average water depths in the various segments of Kress Creek and the West Branch DuPage River vary between two and seven feet. In the shallower areas, placement of capping materials would significantly alter the natural hydraulics of the River, requiring extensive excavation of overburden and sediment or bank soil materials requiring remediation prior to cap placement to avoid any decrease in flood storage capacity. In addition, since the original grade of the floodplain must be maintained, excavation of overburden and contaminated materials would be necessary prior to the installation of the engineered cap. None of these needs pose insurmountable implementability issues; however, they do complicate activities.

There are potential issues with the implementation of Alternative 4 from an administrative feasibility perspective. The primary potential issue is the need for institutional controls to maintain the integrity of the caps (e.g., dam management/maintenance) and the potential for restrictions on land use (e.g., access/deed restrictions) since some contaminated materials would be left in place. Since the Sites are designated as CERCLA sites, permits are not required for on-site activities; however, the substantive requirements of Federal, State and local regulations would need to be met, and necessary approvals would need to be secured. Permits required for off-site activities (i.e., transport of contaminated materials to a disposal area) should be obtainable. Negotiations with a large number of affected landowners would be necessary to secure approvals to use and develop staging areas, haul roads, and access roads and construct the cap. While it is expected that access/approval could be secured, this process could be lengthy.

4.3.4.8 Cost (Alternative 4)

The estimated present worth of this alternative is $67.1 M including $65.5 M for the Kress Creek Site and $1.6 M for the STP Site. This estimate is based on a 32-month construction period followed by a 30-year monitoring program to assess overall conditions using a discount rate of 7% for all present worth calculations (USEPA, July 2000). The long-term monitoring/operation and maintenance program is assumed to include annual monitoring and maintenance of wetlands and other areas (i.e., forested uplands, low and high energy stream banks) for 3 years, and maintenance of residential/commercial areas for 1 year. It is also assumed that surface gamma surveys of the Sites (focusing on targeted areas), bathymetry, and cap observation/maintenance would be performed once every 5 years for a period of 30 years. The total estimated cost is provided in 2004 dollars and all capital cost expenditures are assumed to occur in 2004. The detailed cost estimate is provided in Table 4-5.

5. Comparative Analysis of Remedial Alternatives

5.1 Introduction

In Section 4, the four potential remedial alternatives developed for the Sites were considered individually in detail with regard to seven of the nine NCP criteria. The results of that detailed evaluation are used in this section to conduct a comparative analysis of the alternatives to identify the relative advantages and disadvantages of each alternative. The results of this analysis could be used as a basis for recommending a remedial alternative to address the targeted sediments and floodplain soils at the Sites.

The four alternatives developed for the Sites include:

- Alternative #1: No Action;
- Alternative #2: Monitored Natural Recovery;
- Alternative #3: Excavation and Off-Site Disposal of Targeted Sediment/Soil throughout the Sites; and
- Alternative #4: Capping of Targeted Sediment/Soil throughout the Sites.

5.2 Overall Protection of Human Health and the Environment

The criterion of overall protection of human health and the environment is used to address the overall effectiveness of an alternative in achieving and maintaining protection of human health and the environment. Protection is achieved by reducing potential exposures and meeting the identified RAOs for the Sites.

Alternatives 3 and 4 both include measures to actively address the sediment and floodplain soils at the Sites that contain elevated levels of total radium. Alternative 3 likely affords the highest degree of overall protection since its implementation would result in the excavation and permanent off-site disposal of the largest amount of targeted materials (as described in Section 2.5). Alternative 4 could provide an acceptable level of overall protection, but since some materials would be left in place under engineered caps, there could be potential issues associated with catastrophic events (i.e., severe floods or dam failure) or other long-term alterations in land use. Although Alternative 3 is estimated to cost ten percent more than Alternative 4, it should afford significantly enhanced permanence and protection. The natural processes considered alone in Alternatives 1 and 2 would likely need to continue for a long time period to reduce radioactivity of sediments and floodplain soils below applicable standards. Overall, implementation of Alternatives 3 and 4 would result in the fastest achievement of the primary RAO, both taking approximately 32 months, compared to an extended time period for Alternatives 1 and 2.

A comparison of the four alternatives with respect to the two RAOs follows.

- RAO #1 – All four could eventually achieve RAO #1 (reduce risks to human health and the environment presented by sediments and floodplain soils containing elevated levels of total radium), but a long time period would be required for Alternatives 1 and 2 when compared to Alternatives 3 and 4.

- RAO #2 – Alternatives 1 and 2 would achieve RAO #2 (mitigate, to the extent practicable, potential adverse effects to the environment as a result of implementation of remedial activities) as no active remedial measures are included in these options. Potentially adverse effects during the implementation of Alternatives 3 and 4 could be managed/addressed with appropriate engineering controls. Daily water column and air monitoring would be necessary for both Alternatives 3 and 4 to assess their impact on the environment. The excavations associated with Alternatives 3 and 4 could introduce risks as a result of uncovering and handling sediments or soils with higher radioactivity than is currently present at the surface, but compliance with worker safety regulations would address this and other potential exposure issues.

This RAO also requires a consideration of potential adverse effects after implementation. Again, as Alternatives 1 and 2 do not include any active remedial measures, post-implementation impacts should not be an issue. The long-term monitoring associated with Alternative 2 would be unobtrusive and not result in any adverse impacts to the environment. The implementation of Alternatives 3 and 4 could not avoid adverse impacts to the environment, but measures taken as part of the restoration program would restore the remediated areas and areas used for support services to the extent feasible, and could even provide enhancements to wetlands and forest preserve areas where possible/practical.

5.3 Compliance with ARARs

No action-specific or location-specific ARARs apply to Alternatives 1 or 2 since no active remedial measures would take place. The action-specific and location-specific ARARs considered for Alternatives 3 and 4 could likely be achieved and the substantive requirements of related permits could likely be met through a variety of engineering controls and in the development of the detailed design for either alternative.

Alternatives 1 and 2 could eventually achieve the chemical-specific ARARs. Compared to Alternative 3, however, the natural processes at the Sites under Alternatives 1 and 2 would likely need to continue for a long time period to meet the ARARs. Alternative 4 would not achieve the quantitative levels prescribed in the state or federal chemical-specific ARARs; however, the Federal regulations [40 CFR Part 192.21 (c)] provide "supplemental standards" that may be appropriate under this alternative. In contrast, Alternative 3 is based upon the chemical-specific ARARs found in 40 CFR Part 192 and the Illinois Source Material Milling Regulations, and would meet the ARARs at the end of the 32-month construction period.

5.4 Long-Term Effectiveness and Permanence

The long-term effectiveness and permanence criterion is used to address the effectiveness of a given alternative with respect to reducing exposure and potential risk, and its ability to maintain protectiveness over time. Of the four potential alternatives, Alternative 3 (Excavation and Off-site Disposal of Targeted Sediment/Soil and throughout the Sites) provides the highest degree of long-term effectiveness and permanence. Targeted sediments and floodplain soils would be permanently removed from the Sites and disposed in a licensed off-site facility. As a result, potential risks at the Sites from these targeted materials would be eliminated. Alternatives 1, 2, and 4 all leave contaminated materials at the Sites; therefore, they do not provide the same degree of long-term effectiveness and permanence as Alternative 3. Alternative 4 does perform well, since approximately 65% of the targeted sediments and floodplain soils would be permanently removed and disposed off-site and the remaining materials would be isolated from exposure under engineered caps. Potential risks would still exist, however, due to the possibility for changing land use or catastrophic events. As a result, long-term monitoring and maintenance of the caps would be necessary, along with institutional controls and appropriate maintenance of the Warrenville and McDowell Dams by their owners.

Alternatives 1 and 2 would rely entirely on natural processes to achieve long-term risk reduction. While half-life decay, erosion/re-deposition, and sedimentation/deposition would eventually provide adequate protection, an unacceptably long time period would be required until that protection is achieved. The monitoring component of Alternative 2 would, however, provide periodic data that would be used to track the progress of natural recovery processes at the Sites. When compared to the level of protection, effectiveness, and permanence provided by Alternative 3, and to a somewhat lesser extent by Alternative 4, the No Action and Monitored Natural Recovery alternatives (Alternatives 1 and 2) do not result in the same level of effectiveness or permanence.

5.5 Reduction in Toxicity, Mobility, or Volume through Treatment

Under this criterion, the degree to which each alternative reduces the toxicity, mobility, or volume of contaminated materials through treatment is evaluated. None of the alternatives include any active treatment of contaminated materials; therefore, there would be no reduction in toxicity, mobility, or volume through treatment. All the alternatives do, however, result in varying degrees of reductions. In Alternatives 1 and 2, the mobility of targeted materials would be reduced as they continue to be isolated under a layer of overburden as a result of sedimentation and deposition. In addition, the volume and toxicity of total radium at the Sites would be reduced through half-life decay, although at a very slow rate, and erosion/re-deposition. Alternative 4 would provide additional volume and mobility reductions as approximately 65% of the targeted soils and sediments would be removed from the Sites, and the remainder would be isolated under engineered caps. Volume and mobility reductions would be even more substantial under Alternative 3 since targeted sediments and floodplain soils would be removed from the Sites and disposed in an off-site landfill. Further, the future mobility of materials accumulated behind existing impoundments during a catastrophic event (e.g. dam failure) would be of less concern for Alternative 3.

5.6 Short-Term Effectiveness

This criterion is used to evaluate the impacts and risks associated with alternative implementation, considering protection of the community and workers and the expected effects on the environment. This criterion also considers the effectiveness of mitigative measures and time until protection is achieved through attainment of the RAOs. There would be no short-term impacts associated with the implementation of Alternatives 1 or 2 since they do not include any active remedial measures.

There would be impacts associated with both Alternatives 3 and 4, and the remedial activities would take place throughout the Sites for the duration of implementation. Both the active alternatives would cause disruption along the Creek/River and in the floodplain; impact the water column; alter/destroy the benthic habitat, some wetlands, and forest preserve areas; disrupt boating and other recreation activities on the Creek/River; and, lead to increased truck traffic. Daily monitoring of surface water and ambient air would take place as part of both Alternatives 3 and 4. Results would be used to identify, evaluate, and address measurable effects of construction. Since excavation and capping activities are to take place in-the-dry, individual reaches could flood during construction of Alternative 3 or 4 due to water flow restrictions necessary to implement the alternative. Implementation of appropriate health and safety practices should protect both remediation workers and the community from unacceptable exposure to radioactivity during construction.

5.7 Implementability

This criterion is used to evaluate the implementability of an alternative with respect to both technical and administrative feasibility, including the availability of appropriate services and materials. Technical feasibility includes the ability to construct the various components of the alternative, the reliability of the components, and the ability to effectively monitor the alternative. All four alternatives are technically implementable, and the necessary personnel, equipment, services, and materials are readily available for Alternatives 2, 3, and 4 (since Alternative 1 has no active measures or monitoring, no goods or services are required). From an administrative implementability standpoint, Alternative 3 is likely the best option since all the necessary approvals and permits could be secured, requirements met and access to private property obtained. Since significant quantities of contaminated sediments and floodplain soils would remain in place under Alternatives 2 and 4, extensive deed and access restrictions would likely be necessary to control future land use. In addition, proper maintenance of the Warrenville and McDowell Dams by their owners would be critical to avoid major hydraulic impacts on the remaining materials or the engineered caps. Long-term monitoring would be necessary for Alternative 4 since the engineered caps would have to be monitored and maintained.

5.8 Cost

The estimated present worth costs to implement the four potential remedial alternatives are as follows (in millions of dollars):

- Alternative 1: $0
- Alternative 2: $0.4 M ($0.35 M for the Kress Creek Site and $0.05 M for the STP Site)
- Alternative 3: $73.7 M ($71.9 M for the Kress Creek Site and $1.8 M for the STP Site)
- Alternative 4: $67.1 M ($65.5 M for the Kress Creek Site and $1.6 M for the STP Site)

Details regarding these estimates are included in Tables 4-1, 4-3, and 4-5.

Of the two active remedial options, Alternative 3 would result in the permanent removal of targeted materials at a ten percent increase in cost. In so doing, it will also eliminate difficult to quantify, long-term social and practical “costs” associated with ensuring the integrity of containment.

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Tables

Table 2-1

Kerr McGee Chemical LLC
Kress Creek/West Branch DuPage River and Sewage Treatment Plant Sites
DuPage County, Illinois
Feasibility Study Report

Chemical-Specific ARARs and TBCs

Regulation	Citation	ARAR or TBC	Description	Rationale
FEDERAL ARARs AND TBCs				
Clean Air Act	42 USC 7401; 40 CFR 50 and 52 Subpart O	ARAR	Regulates air emissions from area, stationary, and mobile sources. This law authorizes the U.S. Environmental Protection Agency to establish National Ambient Air Quality Standards (NAAQS) to protect public health and welfare and the environment.	NAAQS have been established which could be considered during development of the monitoring program with regard to establishing action levels.
Clean Water Act [Federal Water Pollution Control Act, as amended]	40 CFR 122, 125, 129, 131; Section 301-303, 306, 307, 401, 404; 33 USC 1251; 33 USC 1314	ARAR	Provides federal, state and local discharge requirements to control pollutants to navigable waters (also includes NPDES).	Establishes relevant and appropriate water quality criteria to protect against adverse effects.
Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings	40 CFR 192	ARAR	USEPA guidance establishes that this provision may provide relevant and appropriate standards for remedial action performed at CERCLA sites with radionuclides.	Relevant to the management of thorium byproduct materials under Section 84 of the Atomic Energy Act of 1954, as amended, during and following processing of thorium ores, and to restoration of disposal sites. Is construed by EPA to set a standard for radium-226 and 228 of 5 pCi/g total radium above background.
Resource Conservation and Recovery Act (RCRA)	40 CFR 261, 262, 264, 268; 42 U.S.C. 6901 et seq.	ARAR	Identifies and lists certain materials as hazardous wastes and sets management standards for such wastes.	Potentially applicable in consideration of management of materials removed from a site if they contain any listed hazardous waste or exhibit a characteristic of a hazard. Would not apply to soil or sediment if it exhibits the “toxicity characteristic” merely because of the presence of elemental metals normally present in thorium ores.
STATE ARARs AND TBCs				
Illinois Uranium and Thorium Mill Tailings Control Act	420 ILCS 42	ARAR	Requires licensees to be prepared to decontaminate all properties that have been identified as being contaminated with by-product material produced at a licensed site.	Thorium mill tailings from the REF are found at the Sites.
Water Pollution – Pollution Control Board	35 IAC, Subtitle C, 302, 304, 309	ARAR	Provides water quality standards applicable throughout the State, and maximum concentration of various contaminants which can be discharged. Also describes the NPDES and other associated permits.	Establishes relevant and appropriate water quality criteria to protect against adverse effects.
Environmental Protection – Pollution Control Board – Radiation Hazards	35 IAC, Subtitle I, Chapter I, Part 1000	ARAR	Establishes standards for protection against radiological air pollutants associated with materials and activities under licenses issued by the United States Nuclear Regulatory Commission pursuant to the Atomic Energy Act of 1954.	Established standards could be considered during development of the monitoring program with regard to establishing action levels.

Table 2-1

Kerr McGee Chemical LLC
Kress Creek/West Branch DuPage River and Sewage Treatment Plant Sites
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Chemical-Specific ARARs and TBCs

Regulation	Citation	ARAR or TBC	Description	Rationale
STATE ARARs AND TBCs (CONT'D)				
Environmental Protection – Air Pollution – Toxic Air Contaminants	35 IAC, Subtitle B, Chapter I, Subchapter f, 232	ARAR	Establishes the procedures to identify a toxic air contaminant.	Established standards could be considered during development of the monitoring program with regard to establishing action levels.
Illinois Radiation Protection Act of 1990	420 ILCS 40-13	TBC	Requires licensees to complete decontamination of all properties identified as being contaminated with byproduct material from a licensed site.	Would be considered during remedial design and remedial action.

Table 2-2

Kerr McGee Chemical LLC
Kress Creek/West Branch DuPage River and Sewage Treatment Plant Sites
DuPage County, Illinois
Feasibility Study Report

Action-Specific ARARs and TBCs

Regulation	Citation	ARAR or TBC	Description	Rationale
			FEDERAL ARARs AND TBCs	
Clean Water Act [Federal Water Pollution Control Act, as amended]	Section 404(b and c) of the Clean Water Act, 33 USC 1344(b and c); 40 CFR Part 230, 231; 33 CFR Part 320-329	ARAR	Guidelines for Specification of Disposal Sites for Dredged or Fill Material. Except as otherwise provided under Clean Water Act Section 404(b)(2), no discharge of dredged or fill material shall be permitted if there is a practicable alternative to the proposed discharge which would have a less adverse impact on the aquatic ecosystem, so long as the alternative does not have other significant adverse environmental consequences. If there is no other practical alternative, impacts must be minimized. Includes criteria for evaluating whether a particular discharge site may be specified.	Applicable to all existing, proposed, or potential disposal sites for discharges of dredged or fill materials into U.S. waters, which include wetlands. Includes special policies, practices, and procedures to be followed by the U.S. Army Corps of Engineers in connection with the review of applications for permits to authorize the discharge of dredged or fill material into waters of the U.S. pursuant to Section 404 of the Clean Water Act.
Rivers and Harbors Act of 1899 (Section 10 Permit)	33 USC 403; 33 CFR Parts 320-330	ARAR	Prohibits unauthorized obstruction or alteration of any navigable water in the U.S. (dredging, fill, cofferdams, piers, etc.). The U.S. Army Corps of Engineers approval is generally required to excavate or fill, or in any manner to alter or modify the course, location, condition, or capacity of the channel of any navigable water of the U.S.	Applicable to remedial activities that include dredging and/or capping.
OSHA-Hazardous Waste Operations and Emergency Response	29 CFR 1910,120; 29 CFR 1904.2; 29 CFR 1910.1020	ARAR	Establishes health and safety requirements for clean-up operations at NPL sites.	Sites are listed on the NPL.
Hazardous Materials Table, Special Provisions, Hazardous Materials Communications, Emergency Response Information, and Training Requirements	49 CFR 172.700	ARAR	Establishes training requirements for hazmat employees.	Applicable for site activities involving active remediation.
Oil Pollution Prevention and Response; Non-Transportation-Related Onshore and Offshore Facilities	40 CFR 112	ARAR	Establishes requirements for Spill Prevention, Control, and Countermeasure (SPCC) Plans.	Applicable for site activities involving active remediation.

Table 2-2

Kerr McGee Chemical LLC
Kress Creek/West Branch DuPage River and Sewage Treatment Plant Sites
DuPage County, Illinois
Feasibility Study Report

Action-Specific ARARs and TBCs

Regulation	Citation	ARAR or TBC	Description	Rationale
FEDERAL ARARs AND TBCs (CONT'D)				
USDOT Placarding and Handling	49 CFR 171	ARAR	Provides transportation and handling requirements for hazardous materials.	Applicable for alternatives where materials are removed and transported from the Sites.
Solid Waste Disposal Act, as amended	40 CFR 261-265, 268	ARAR	Establishes a characteristic test of the presence of hazardous constituents at levels that could make remedial residues hazardous wastes, and establishes requirements for management, transport, and land disposal of such materials.	Applicable to remedial activities involving transport and disposal of material.
USEPA Remedial Design/Remedial Action Handbook		TBC	General reference manual that provides remedial project managers with an overview of the remedial design and remedial action processes.	Would be consulted during remedial design and remedial action.
USEPA Superfund Remedial Design and Remedial Action Guidance	OSWER Directive No. 9355.0-4A, June 1986	TBC	Guidance document developed to assist agencies and parties who plan, administer, and manage remedial design and remedial action at Superfund sites.	Would be consulted during remedial design and remedial action.
STATE ARARs AND TBCs				
Department of Nuclear Safety – Transportation of Radioactive Material	32 IAC, Chapter II, 341	ARAR	Establishes requirements for packaging, preparation for shipment and transportation of radioactive material and applies to any person who transports radioactive material or delivers radioactive material to a carrier for transport.	Applicable to remedial activities involving transport of material.
Floodway Construction in Northeastern Illinois	17 IAC, Title 17, Chapter I, Part 3708	ARAR	Provides rules governing construction and filling in the regulatory floodway of rivers, lakes and streams of Cook, DuPage, Kane, Lake, McHenry and Will Counties, excluding the City of Chicago so that periodic inundation will not pose a danger to the general health and welfare of the user, require the expenditure of public funds, require the provision of public resources or disaster relief services, and result singularly or cumulatively in greater flood damages or potential flood damages due to increases in flood stage or velocities or loss of flood storage.	Would apply to remedial activities that include dredging and/or capping.
Hazardous Material Transportation Regulations	IDOT Title 92, Chapter I, Subchapter C	ARAR	Designates the requirements of the Illinois Department of Transportation governing the transportation of hazardous wastes including discussion of carrying waste by highway and specifications for tank cars and packaging.	Applicable to remedial activities involving transport of material.
Illinois Urban Manual	IEPA/USDA, NRCS; 1995	ARAR	Provides construction standards and specifications, material specifications, and standard drawings related to urban ecosystem protection and enhancement.	Applicable for site activities including active remediation.

Table 2-2

Kerr McGee Chemical LLC
Kress Creek/West Branch DuPage River and Sewage Treatment Plant Sites
DuPage County, Illinois
Feasibility Study Report

Action-Specific ARARs and TBCs

Regulation	Citation	ARAR or TBC	Description	Rationale
STATE ARARs AND TBCs (CONT'D)				
Licensing Requirements for Land Disposal of Radioactive Waste	32 IAC 605	ARAR	Establishes procedures, criteria, and terms and conditions upon which the Department of Nuclear Safety issues licenses for the land disposal of radioactive wastes if such disposal is away from the point of generation or if such disposal is of waste which has been received from other persons.	Applicable to remedial activities involving transport of material.
Nuclear Safety – Uranium and Thorium Mill Tailings Control Act	420 ILCS 42	ARAR	Establishes a comprehensive program for the timely decommissioning of uranium and thorium mill tailing facilities in Illinois and for the decontamination of properties that are contaminated with uranium or thorium mill tailings (in addition to the regulatory program established in the Radiation Protection Act of 1990).	Applicable to remedial activities involving transport of material.
Procedures and Criteria for Federal Permits or Licenses for Discharge Into Waters of the State	35 IAC 395	ARAR	These rules state the procedures and criteria which the Illinois Environmental Protection Agency will use in certifying, under Section 401 of the Clean Water Act, that activities requiring federal permits of licenses will comply with Sections 301, 302, 202m 306, and 307 of the Clean Water Act.	Applicable to remedial activities that include dredging and/or capping.
Regulation of Construction Within Floodplains	92 IAC, Part 708; 17 IAC, Title 17, Chapter I, Part 3706	ARAR	Provides protection of public health, safety, and general welfare by restricting damageable floodplain improvements and uses which increase flood damage potential elsewhere. The regulation is more specifically adopted to: - Protect adjacent, upstream, and downstream private and public landowners from increases in flood heights and velocities and resulting increases in flood damage; - Minimize extraordinary direct/indirect costs to governmental units caused by developments within flood plains for roads, sewer and water, flood control works, flood relief and emergency services; - Reduce health and safety risks to the individual, family or guests, prevent blighting, and prevent economic losses detracting from community well-being and the tax base; - Protect individuals from buying lands which are unsuited for intended purposes because of flood hazard; and - Prevent water pollution, nuisances due to floating structures/debris, and increased sedimentation.	Applicable for site activities involving active remediation.
Rivers, Lakes, and Streams Act	615 ILCS (1996 State Bar Edition)	ARAR	Regulates construction activities in floodplains with a focus on preserving the hydrological integrity of the state's public waters.	Applicable for site activities involving active remediation.
Environmental Protection – Pollution Control Board – Waste Disposal – Site Remediation Program	35 IAC, Subtitle G, Chapter I, Part 740	TBC	Establishes procedures for the investigative and remedial activities at sites where there is a release, threatened release, or suspected release of hazardous substances, pesticides, or petroleum and for the review and approval of those activities.	Applicable to implementation of remedial activities.

Table 2-2

Kerr McGee Chemical LLC
Kress Creek/West Branch DuPage River and Sewage Treatment Plant Sites
DuPage County, Illinois
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Action-Specific ARARs and TBCs

Regulation	Citation	ARAR or TBC	Description	Rationale
STATE ARARs AND TBCs (CONT'D)				
Rules for Regulation of Public Waters	92 IAC, Part 704; 17 IAC, Title 17, Chapter I, Part 3704	ARAR	Provides protection of the public's interest, rights, safety and welfare in the State's public bodies of water. More specifically, construction will be regulated to prevent obstruction to, or interference with, the navigability of any public body of water; encroachment on any public body of water; and impairment of the rights, interests or uses of the public in any public body of water or in the natural resources thereof.	Applicable to remedial activities that include dredging and/or capping.
Standards and Specifications for Soil Erosion and Sediment Control	IEPA/WPC/87-012	ARAR	Provides standards and specifications for design and construction of erosion control measures.	Construction activities should be planned and constructed in accordance with the specifications outlined in the Illinois Urban Manual, especially as it relates to erosion control measures.
Transportation of Radioactive Material	32 IAC 341	ARAR	Establishes requirements for packaging, preparation for shipment and transportation of radioactive material and applies to any person who transports radioactive material or delivers radioactive material to a carrier for transport.	Applicable to remedial activities involving transport of material.
Standards for Protection Against Radiation	32 IAC 340	ARAR	Establishes standards for protection against radiation during receipt, possession, use, transfer, and disposal of radiation sources.	Applicable for site activities involving active remediation.
Waste Disposal – Pollution Control Board	35 IAC, Subtitle G, 721-722, 728, 808-809	ARAR	Includes the Identification And Listing Of Hazardous Waste, Standards Applicable To Generators Of Hazardous Waste, Standards For Owners And Operators Of Hazardous Waste Treatment, Storage, And Disposal Facilities, Land Disposal Restrictions, Special Waste Classifications, and Nonhazardous Special Waste Hauling and the Uniform Program. The regulations identify those solid wastes which are subject to regulation as hazardous wastes; establish standards for generators of hazardous waste; identifies hazardous wastes that are restricted from land disposal and defines those limited circumstances under which an otherwise prohibited waste may continue to be land disposed; provides a means by which persons may obtain a classification or declassification of special (non-RCRA) waste based on the degree of hazard of the waste or other characteristics, to assure that the waste receives appropriate handling; and prescribes the procedures for the Uniform Hazardous Materials Transportation and Registration Program and for the issuance of permits to nonhazardous special waste transporters; for the inspection and numbering of vehicles; and for proper hauling of special wastes to approved disposal, storage and treatment sites.	Applicable to remedial activities involving transport of material.

Table 2-2

Kerr McGee Chemical LLC
Kress Creek/West Branch DuPage River and Sewage Treatment Plant Sites
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Action-Specific ARARs and TBCs

Regulation	Citation	ARAR or TBC	Description	Rationale
			LOCAL TBCs	
DuPage County Countywide Stormwater and Floodplain Ordinance	Ordinance No. OSM-0001-89	TBC	Required for development (i.e., excavation or fill, alteration, change in land use, or activities affecting stormwater discharge) that affects both a floodplain/riparian area and a wetland.	Applicable for site activities involving active remediation.
DuPage County Right of Way Permit, License and Fee Ordinance	Ordinance No. ODT-0007-97	TBC	Applies to any work conducted within County designated highway routes including storm sewer, sanitary sewer, water main, residential/commercial, left/right turn widening, sidewalk, grading, landscaping, street lighting, signage, traffic signals, parades, temporary road closures/detours, etc.	Would apply during activities involving use of County designated highway routes.
Kane/DuPage County Erosion and Sediment Control Plan Application	Condition of Section 404 Clean Water Act Permit Issuance – DuPage County signed Memorandum of Understanding on 6/12/97	TBC	Requires appropriate soil erosion and sediment control measures to be implemented and maintained until the construction site is vegetated and stabilized.	Applicable for site activities involving active remediation.

Table 2-3

Kerr McGee Chemical LLC
Kress Creek/West Branch DuPage River and Sewage Treatment Plant Sites
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Location-Specific ARARs and TBCs

Regulation	Citation	ARAR or TBC	Description	Rationale
FEDERAL ARARs AND TBCs				
Endangered Species Act	16 USC 1531-1544; 50 CFR Part 17, Subpart I; 50 CFR Part 402	ARAR	Federal agencies are required to verify that any action authorized, funded, or carried out by them is not likely to jeopardize the continued existence of any endangered species or threatened species, or result in the destruction or adverse modification of a critical habitat of such species, unless such agency has been granted an appropriate exemption by the Endangered Species Committee (16 USC § 1536).	Applicable.
Fish and Wildlife Coordination Act	16 USC, 661-666	ARAR	Whenever the waters of any stream or other body of water are proposed or authorized to be impounded, diverted, the channel deepened, or the stream or other body of water otherwise controlled or modified for any purpose, by any department or agency of the United States, such department or agency first shall consult with the United States Fish and Wildlife Service, Department of the Interior, and with the head of the agency exercising administration over the wildlife resources of the particular State in which the impoundment, diversion, or other control facility is to be constructed, with a view to the conservation of wildlife resources by preventing loss of and damage to such resources.	Applicable.
National Environmental Policy Act	42 USC Sect 4321 et. seq.; 40 CFR Sect. 6 Subpart C	ARAR	Establishes the broad national framework for protecting our environment and assures that all branches of government give proper consideration to the environment prior to undertaking any major federal action that significantly affects the environment. Requirements are invoked when airports, buildings, military complexes, highways, parkland purchases, and other federal activities are proposed. Environmental Assessments (EAs) and Environmental Impact Statements (EISs), which are assessments of the likelihood of impacts from alternative courses of action, are required from all Federal agencies and are the most visible NEPA requirements.	NEPA requires the USACE to conduct an Environmental Assessment to determine whether an EIS is required. An EIS is required for "major federal activities significantly affecting the environment." This process is generally performed concurrent with the review of the Section 404 permit (potentially via the joint application process).
Preservation of Historical and Archaeological Data Act and National Historic Preservation Act (NHPA)	16 USC, 469; 36 CFR Part 65; 16 USC 470; 36 CFR Part 800	ARAR	Establishes requirements for the recovery and preservation of historical and archaeological data. Also requires measure to minimize harm to historic resources. Response actions must take into account effect on properties on or eligible for inclusion on the National Registry of Historic Places.	Applicable.

Table 2-3

Kerr McGee Chemical LLC
Kress Creek/West Branch DuPage River and Sewage Treatment Plant Sites
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Feasibility Study Report

Location-Specific ARARs and TBCs

Regulation	Citation	ARAR or TBC	Description	Rationale
FEDERAL ARARs AND TBCs (CONT'D)				
Statement of Procedures on Floodplain Management and Wetland Protection	44 CFR Part 9	ARAR	Sets forth EPA policy and guidance for carrying out Executive Orders 11990 and 11988. Executive Order 11988: Floodplain Management requires federal agencies to evaluate the potential effects of actions they may take in a floodplain to avoid, to the extent possible, adverse effects associated with direct and indirect development of a floodplain. Federal agencies are required to avoid adverse impacts or minimize them if no practicable alternative. Executive Order 11990: Protection of wetlands requires federal agencies conducting certain activities to avoid, to the extent possible, adverse impacts associated with the destruction or loss of wetlands if a practicable alternative exists. Federal agencies are required to avoid adverse impacts or minimize them if no practicable alternative exists.	Applicable if remedial action is expected to affect floodplains or identified wetlands areas.
Wilderness Act	16 USC 1131, 50 CFR 35.1	ARAR	Restricts activities in federally-owned wilderness areas to ensure it remains unimpacted.	Applicable.
EPA Office of Solid Waste And Emergency Response - Policy of Floodplains and Wetland Assessments for CERCLA Actions, August 1985		TBC	This memorandum discusses situations that require preparation of a floodplains or wetland assessment, and the factors that should be considered in preparing an assessment, for response actions taken pursuant to Section 104 or 106 of CERCLA.	Would be consulted with respect to any floodplains or wetlands assessments that need to be performed.
STATE ARARs AND TBCs				
Illinois Endangered Species Protection Act	520 ILCS 10 (1994 State Bar Edition)	ARAR	It is unlawful for any person to possess, take, transport, sell, offer for sale, give or otherwise dispose of any animal or the product thereof of any animal species which occurs on the Illinois List, or to deliver, receive, carry, transport or ship in interstate or foreign commerce plants listed as endangered by the Federal government without a permit, and to take plants on the Illinois list without the expressed written permission of the landowner or to sell or offer for sale plant or plant products of endangered species on the Illinois list.	Applicable.

Table 2-3

Kerr McGee Chemical LLC
Kress Creek/West Branch DuPage River and Sewage Treatment Plant Sites
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Location-Specific ARARs and TBCs

Regulation	Citation	ARAR or TBC	Description	Rationale
STATE ARARs AND TBCs (CONT'D)				
Illinois Environmental Protection Act	415 ILCS 5	ARAR	It is the purpose of this act to establish a unified, state-wide program supplemented by private remedies, to restore, protect and enhance the quality of the environment, and to assure that adverse effects upon the environment are fully considered and borne by those who cause them.	Applicable to site activities involving active remediation.
Illinois State Agency Historic Resources Preservation Act	20 ILCS 3420, as amended, 17 IAC 4180	ARAR	Requires an assessment of all state funded, permitted or licensed work to determine whether prehistoric or historic cultural resources are present within the project area. If probability of archaeological resources present within the project area, an archaeological survey would be required.	Applicable.
Interagency Wetland Policy Act of 1989	20 ILCS 830	ARAR	Directs that the State Agencies shall be preserve, enhance, and create wetlands where possible and avoid adverse impacts to wetlands in order to maintain the economic and social values of the State's remaining wetlands.	Applicable if remedial action is expected to affect floodplains or identified wetlands areas.
LOCAL TBCs				
An Ordinance Establishing Rules and Regulations for the Granting of Easements and Licenses by the Forest Preserve District of DuPage County and Providing for the Partial Repeal of Ordinance No. 9-22	Ordinance No. 96-096	TBC	This Ordinance establishes rules and regulations governing granting of easements and licenses by the District to protect and preserve the property, natural areas, forests, trees, vegetation, wildlife, scenic beauties, natural resources, flora and fauna, facilities, and improvements of the District.	Applicable to site activities involving active remediation.

Table 2-4

Kress Creek/West Branch DuPage River and Sewage Treatment Plant Sites
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Summary of Targeted Material Volume

Geographic Location	Estimated Volume (cubic yards)						
	Sediment Materials		Floodplain Materials		Total		Total (Rounded)
	Targeted Material	Overburden Material	Targeted Material	Overburden Material	Targeted Material	Overburden Material	
Kress Creek: Outfall to May Street	1,700	500	5,000	1,400	6,700	1,900	9,000
Kress Creek: May Street to Joy Road	3,900	1,000	3,600	900	7,500	1,900	9,000
Kress Creek: Joy Road to Route 59	700	100	6,200	1,100	6,900	1,200	8,000
Kress Creek: Route 59 to Confluence	100	100	3,200	400	3,300	500	4,000
West Branch DuPage River: STP to Confluence	200	100	2,000	1,000	2,200	1,100	3,000
West Branch DuPage River: Confluence to Williams Road	1,000	600	11,200	7,100	12,200	7,700	20,000
West Branch DuPage River: Williams Road to Butterfield Road	700	900	1,300	1,600	2,000	2,500	5,000
West Branch DuPage River: Butterfield Road to Warrenville Dam	24,500	15,500	1,300	800	25,800	16,300	42,000
West Branch DuPage River: McDowell Grove Area	10,000	14,700	0	0	10,000	14,700	25,000
Rounded Total:	43,000	34,000	34,000	14,000	77,000	48,000	125,000

Notes:
1. Total surface areas were calculated by summing surface areas (obtained from ArcView) for all individual areas within a specified reach. Volumes were calculated using the average depth of overburden and targeted material provided for all boreholes within each area and multiplying by the total surface area.
2. Volumes were further separated by sediment or floodplain based on the percent of total surface area for each reach that exists within or outside of the Creek/River boundary.
3. The areal extent of targeted material is illustrated on Figure 2-1.
4. Kerr-McGee is performing additional characterization (i.e., surface scanning and if necessary, downhole drilling) in specific areas of the Sites, including the stretch of the River between the Warrenville and McDowell Dams. Volumes provided in this document do not take into account this future characterization, and therefore may require modification based on the results of the additional characterization work.

Table 3-1

Kress Creek/West Branch DuPage River and Sewage Treatment Plant Sites
DuPage County, Illinois
Feasibility Study Report

Initial Screening of Potential Remedial Technologies for Sediment and Soil[1]

General Response Action/ Technology Type	Process Option	Description	Preliminary Assessment
A. No Action			
	----	No remedial activities. Ongoing natural processes would continue.	Implementable.
B. Monitoring and Institutional Controls			
1. Monitoring	Site-Wide Monitoring	Periodic visual observations and/or field sampling and analysis would be used to monitor conditions.	Implementable.
2. Institutional Controls	Access Restrictions	Constraints, such as fencing and signs, would be placed throughout the Sites to limit access to targeted soil removal areas and the Creek/River.	Implementable.
	Deed Restrictions	Constraints would be placed on future land and Creek/River use.	Implementable.
C. Source Control/Natural Recovery			
1. Source Control	Source Control	Constraints/controls placed on point sources to reduce discharge of identified contaminants to the Creek/River.	Implementable; source control activities performed at upland portion of STP Site and through closure at REF.
2. Natural Recovery	Natural Processes	Naturally occurring physical (e.g., radiochemical decay, sedimentation, dilution), and chemical processes (e.g., stabilization, sorption) that reduce contaminant exposure, toxicity, and mobility.	Implementable.
D. In-Place Containment			
1. Cap/Cover	Engineered Cap/Cover	Placement of a cap typically comprised of layered materials (e.g., sand, gravel, cobbles, geotextile) over in-situ sediment/soil to isolate contaminants from biota/overlying water column and mitigate erosion.	Implementable.
	Aqua-Blok™ Cap	Engineered pellets placed through the water column settling over the sediment. The bentonite coated pellets absorb water, coalesce, and form a relatively impermeable layer.	Implementable.
	Asphalt Cap	Application of an asphalt or concrete layer over contaminated sediment/soil.	Implementable.
2. Hydraulic Modification/ Rechannelization	----	Hydraulic modification includes construction/demolition of dams or similar structures to alter the rate of sedimentation in portions of the Creek/River. Rechannelization involves re-routing the Creek/River from its existing flow path.	Implementable for Creek/River portion of the Sites; not applicable for upland areas.

Table 3-1
(cont'd)

Kress Creek/West Branch DuPage River and Sewage Treatment Plant Sites
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Initial Screening of Potential Remedial Technologies for Sediment and Soil[1]

General Response Action/ Technology Type	Process Option	Description	Preliminary Assessment
E. Sediment/Soil Treatment			
1. Immobilization	In-Situ Stabilization/Solidification	Chemically immobilize materials by injecting and mixing a stabilization/solidification agent into the in-situ sediment/soil.	In-situ process not yet sufficiently developed.
	Ex-Situ Stabilization/Solidification	Removed materials are mixed ex-situ with Portland cement, fly ash, or some other stabilization agent. May be used for dewatering only, or to reduce the mobility of contaminants.	Implementable.
2. Extraction, In-Situ	Soil Flushing	Water along with solvents introduced in soil, extraction wells recover solvent and extracted contaminants.	Implementable for soils; not applicable for sediments. Limited effectiveness.
3. Extraction, Ex-Situ	Soil Washing (VORCE)	Soil washing process is accomplished by treatment of whole soil to liberate whole soil particles, by hydroclassification and wet screening, and collection of the product streams. Processes take advantage of differences in effective particle size of the contaminated and non-contaminated materials.	Process has not been demonstrated at full-scale.
	Vitrification	Uses electric power to melt soil at extremely high temperatures; melted material cools to form glassy solid.	Process has not been demonstrated at large scale.
	Physical Separation	System works by conveying radioactive contaminated materials under arrays of sensitive radiation detectors. Contaminated materials are continuously separated from clean materials by gates and with separated materials moved by conveyor and placed into storage container.	Implementable.

Table 3-1
(cont'd)

Kress Creek/West Branch DuPage River and Sewage Treatment Plant Sites
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Initial Screening of Potential Remedial Technologies for Sediment and Soil[1]

General Response Action/ Technology Type	Process Option	Description	Preliminary Assessment
F. Sediment/Soil Removal			
1. Dredging (sediment)	Mechanical	Remove sediment by directly applying mechanical force to dislodge and excavate materials (e.g., clamshell bucket).	Implementable for sediment; not applicable for soils although similar equipment can be used for soil removal.
	Hydraulic	Removal and transportation of bottom sediment in a liquid slurry form using hydraulic pumps (e.g., horizontal auger, cutterhead dredge).	Implementable for sediment; not applicable for soils.
	Pneumatic	Removal of bottom sediment by compressed air (e.g., PNEUMA pump).	Implementable for sediment; not applicable for soils.
	Amphibious	Removal of bottom sediment through mechanical, hydraulic, and pneumatic means using specialized amphibious dredging equipment.	Implementable for sediment; not applicable for soils.
2. Excavation (in-the-dry)	Mechanical	Install temporary structures (e.g., cofferdams and sheetpiling) used to create "dry" areas in the Creek/River to allow use of standard excavation equipment for sediment removal. Use of standard excavation equipment to remove soil on land.	Implementable.
G. Sediment/Soil Dewatering			
1. Filtration	Plate and Frame Filter Press	Sediment slurry pumped into cavities formed by a series of plates covered by a filter cloth. Liquids are forced through filter cloth and dewatered solids collected in the filter cavities.	Implementable.
	Belt Filter Press	Sediment slurry drops onto a perforated belt where gravity drainage takes place. Thickened solids are pressed between a series of rollers to further dewater solids.	Implementable.
2. Centrifuge	Solid-Bowl	Sediment/soil slurry fed through a central pipe that sprays into a rotating bowl. Centrate discharges out the large end of the bowl and solids are removed from tapered end of the bowl by means of a screw conveyer.	Implementable.
3. Hydrocyclone	Hydrocyclone	Sediment/soil slurry fed tangentially into a funnel-shaped unit to facilitate centrifugal forces necessary to separate solids from liquids. Dewatered solids collected and overflow liquid discharged.	Implementable.
4. Gravity Drainage	----	Sediment/soil is stockpiled and water drains via gravity.	Implementable.

Table 3-1
(cont'd)

Kress Creek/West Branch DuPage River and Sewage Treatment Plant Sites
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Initial Screening of Potential Remedial Technologies for Sediment and Soil[1]

General Response Action/ Technology Type	Process Option	Description	Preliminary Assessment
H. Sediment/Soil Disposal			
1. On-Site Disposal	Confined Disposal Facility	Sediment or residuals placed in disposal facility consisting of sheet piling and/or earthen dikes within a water body.	Suitable site has not been identified at the Sites.
2. Off-Site Disposal	Landfill	Disposal of solids or residuals in licensed/permitted landfill that accepts contaminated materials.	Implementable.
I. Residuals Management			
1. Water Treatment	Distillation	Contaminants separated from aqueous stream by vaporization and condensation.	Likely not applicable for radioactive materials in aqueous stream.
	Filtration	Contaminants filtered out through various media (i.e., sand) from the liquid stream.	Implementable.

Note:

1 This screening analysis is based on technical implementability without consideration of cost. Remedial technologies that have not been demonstrated at full-scale were not retained for further analysis; although this does not preclude their potential use during remedial design. A process option that is implementable for either sediment or soil was retained for further analysis, but would need to be selected in combination with another process option to address other media. Shaded process options have been retained for further analysis on Table 3-2.

Table 3-2

Kress Creek/West Branch DuPage River and Sewage Treatment Plant Sites
DuPage County, Illinois
Feasibility Study Report

Evaluation of Process Options for Sediment and Soil

General Response Action/Remedial Technology	Process Option	EFFECTIVENESS			IMPLEMENTABILITY		RELATIVE COST[1]
		Ability to Meet RAOs	Implementation Effects	How Proven and Reliable is the Technology?	Technical Feasibility	Administrative Feasibility	
A. No Action							
	---	RAO #1 may eventually be met through ongoing naturally occurring processes, however would occur over a long time period; RAO #2 would be met immediately.	None.	Reliable.	Implementable.	Implementable with no permits/equipment required.	Very low.
B. Monitoring and Institutional Controls							
1. Monitoring	Site-Wide Monitoring	Periodic visual observations and/or field sampling to monitor the Sites conditions. RAO #1 would eventually be met through ongoing naturally occurring processes, however would occur over a long time period; RAO #2 would be met immediately.	Minimal.	Reliable means to track the Sites conditions; applied at numerous other sites.	Implementable.	Implementable, with specialized services required and available. Permits not required under CERCLA, although substantive requirements should be met.	Low to moderate.
2. Institutional Controls	Access Restrictions	Deters public (e.g., by signs) from accessing land and/or Creek/River. Expected to reduce potential for contact with soil/sediment. RAO #1 would eventually be met through ongoing naturally occurring processes; however would occur over a long time period. Would meet RAO #2 immediately.	None.	Somewhat reliable, varies on extent of notification program, enforcement, and compliance by public.	Implementable. Routine maintenance may be necessary.	Implementable, but may present maintenance difficulties over long periods of time and substantial lengths of Creek/River. Also, likely difficult to implement in on land areas as these are located on residential, commercial, park and forest lands.	Low to moderate.
	Deed Restrictions	Informs property owners of potential risks associated with properties. Would meet RAO #1 eventually through ongoing naturally occurring processes; however would occur over a long time period. Would meet RAO #2 immediately.	None.	Reliable; applied at numerous other sites.	Implementable.	Potentially implementable. Negotiations with affected landowners would be necessary and land use would be restricted.	Low to moderate.

Table 3-2

Kress Creek/West Branch DuPage River and Sewage Treatment Plant Sites
DuPage County, Illinois
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Evaluation of Process Options for Sediment and Soil

General Response Action/Remedial Technology	Process Option	EFFECTIVENESS			IMPLEMENTABILITY		RELATIVE COST[1]
		Ability to Meet RAOs	Implementation Effects	How Proven and Reliable is the Technology?	Technical Feasibility	Administrative Feasibility	
C. Source Control/Natural Recovery							
1. Source Control	Source Control	Reduces influx to Creek/River thus enhancing natural recovery and lessening the time to reach RAOs. RAO #1 would eventually be met through naturally occurring processes; however would occur over a long time period. RAO #2 would be met immediately.	Source control activities have been completed and there are no additional identified sources.	Activities have been reliable in reducing/eliminating releases to Creek/River.	Technically feasible based on results of already completed activities.	Implementable since on-site activities complete; future permits, if necessary, are expected to be obtainable.	Specific to source under evaluation.
2. Natural Recovery	Natural Processes	Includes physical and chemical processes that would provide for natural recovery of the Sites. RAO #1 would eventually be met through naturally occurring processes; however would occur over a long time period. RAO #2 would be met immediately.	None.	Reliable; applied at numerous other sites.	Implementable.	Natural process; no permits, specialized equipment, or personnel are necessary.	Very low.
D. In-Place Containment							
1. Cap/Cover	Engineered Cap/Cover	Includes placement of clean materials over contaminated sediment/soil. Should be effective in isolating contaminants. Would eventually meet RAO #1 through naturally occurring processes, however would occur over a long time period. Additional clean material would enhance current overburden isolation layer. There would be some adverse effects (RAO #2) associated with cap placement.	Would disturb existing habitats. Potential effects could be reduced by use of engineering controls to mitigate release of sediment/cap material resuspended during cap construction. Addition of a cap on top of existing floodplain grade would alter floodway conveyance. Would increase truck traffic in the area during capping.	Capping has been demonstrated at a number of sites nationwide (and under a variety of aquatic sites conditions) to isolate sediments/soils.	Implementable.	Expected to be implementable. Permits not required under CERCLA, although substantive requirements should be met. Equipment, materials and personnel are commercially available.	Moderate.

Table 3-2

Kress Creek/West Branch DuPage River and Sewage Treatment Plant Sites
DuPage County, Illinois
Feasibility Study Report

Evaluation of Process Options for Sediment and Soil

General Response Action/Remedial Technology	Process Option	EFFECTIVENESS			IMPLEMENTABILITY		RELATIVE COST[1]
		Ability to Meet RAOs	Implementation Effects	How Proven and Reliable is the Technology?	Technical Feasibility	Administrative Feasibility	
D. In-Place Containment (cont'd)							
1. Cap/Cover (cont'd)	AquaBlok™ Cap	Includes placement of clean materials over contaminated sediment/soil. Should be effective in isolating contaminants. Would eventually meet RAO #1 through naturally occurring processes, however would occur over a long time period. Additional clean material would enhance current overburden isolation layer. There would be some adverse effects (RAO #2) associated with cap placement.	Would disturb existing habitats. Potential effects could be reduced by use of engineering controls to mitigate release of sediment/cap material resuspended during cap construction. Would increase truck traffic in the area during capping.	Capping with AquaBlok™ has been demonstrated to isolate sediments. Use of AquaBlok™ materials not as common as natural materials (i.e., sand, gravel, etc.).	Implementable.	Expected to be implementable. Permits not required under CERCLA, although substantive requirements should be met. Equipment, materials and personnel are commercially available.	Moderate to high.
	Asphalt Cap	Includes placement of clean materials over contaminated sediment/soil. Should be effective in isolating contaminants. Would eventually meet RAO #1 through naturally occurring processes, however would occur over a long time period. Additional clean material would enhance current overburden isolation layer. There would be some adverse effects (RAO #2) associated with cap placement.	Would disturb existing habitats. Potential effects could be reduced by use of engineering controls to mitigate release of sediment/cap material resuspended during cap construction. Would increase truck traffic in the area during capping.	Capping with asphalt has been demonstrated to isolate soils; however this process is not typically applied to sediment.	Implementable. Typically used only for land soil areas, but could be implemented for sediments if overlying water is diverted during construction.	Expected to be implementable. Permits not required under CERCLA, although substantive requirements should be met. Equipment, materials and personnel are commercially available.	Moderate.
2. Hydraulic Modification/ Rechannelization	----	Includes modification of Creek/River control structures to increase sedimentation and creation of a new channel for Creek/River water flow. Will provide isolation of contaminated sediments. Would eventually meet RAO #1, however would occur over a long time period. There would be some adverse effects (RAO #2) associated with the modifications/rechannelization.	Would disturb existing habitats. Potential effects could be reduced by use of engineering controls to mitigate release of sediment/cap material resuspended during cap construction.	Reliable; has been selected as part of remedial actions for other sites.	Only applicable in limited portions of Creek/River where physical configuration and limited surrounding land development exist. Only suitable for sediment remediation.	Expected to be implementable. Permits not required under CERCLA, although substantive requirements should be met. Equipment, materials and personnel are commercially available.	Moderate to high.

Table 3-2

Kress Creek/West Branch DuPage River and Sewage Treatment Plant Sites
DuPage County, Illinois
Feasibility Study Report

Evaluation of Process Options for Sediment and Soil

General Response Action/Remedial Technology	Process Option	EFFECTIVENESS			IMPLEMENTABILITY		RELATIVE COST[1]
		Ability to Meet RAOs	Implementation Effects	How Proven and Reliable is the Technology?	Technical Feasibility	Administrative Feasibility	
E. Sediment/Soil Treatment							
1. Immobilization	Ex-Situ Stabilization/ Solidification	Does not meet RAOs alone, but may be considered in conjunction with other technologies to form potential remedial actions (e.g., removal, dewatering, disposal, residuals management) that eventually would be expected to meet RAOs.	Reduces mobility of contaminants but increases disposal volume. Potential effects (i.e., potential safety concerns during material transport, handling, and processing) could be reduced through engineering controls.	Process option has been shown to be effective ex-situ and demonstrated full-scale at several sites. Commonly used to reduce free moisture for disposal purposes.	Implementable.	Implementable. Equipment, materials, and technical support available.	Moderate.
2. Extraction, In-Situ	Soil Flushing	Does not meet RAOs alone, but may be considered in conjunction with other technologies to form potential remedial actions (e.g., removal, dewatering, and residuals management) that eventually may meet RAOs.	Potential impacts could be mitigated through use of engineering controls. Extraction residuals may have limited disposal options. Technology limited by subsurface obstructions and dense soil layers.	Has been used full-scale for soils. A site-specific study would be required to assess treatment effectiveness.	Implementable for soils, but not sediments. Used to separate fine materials from coarse materials.	Expected to be implementable. Limited number of full-scale units available.	Moderate to high.
3. Extraction, Ex-Situ	Physical Separation	Does not meet RAOs alone, but may be considered in conjunction with other technologies to form potential remedial actions (e.g., removal, dewatering, and residuals management) that eventually may meet RAOs.	Potential impacts could be mitigated through use of engineering controls. Limited in type of radioactivity screened. Particle size and moisture content of materials may affect performance. System sensitive to environmental elements such as rain.	Has been used full-scale. A site-specific study would be required to assess treatment effectiveness.	Implementable.	Expected to be implementable.	Moderate to high.

Table 3-2

Kress Creek/West Branch DuPage River and Sewage Treatment Plant Sites
DuPage County, Illinois
Feasibility Study Report

Evaluation of Process Options for Sediment and Soil

General Response Action/Remedial Technology	Process Option	EFFECTIVENESS			IMPLEMENTABILITY		RELATIVE COST[1]
		Ability to Meet RAOs	Implementation Effects	How Proven and Reliable is the Technology?	Technical Feasibility	Administrative Feasibility	
F. Sediment/Soil Removal							
1. Dredging	Mechanical	Does not meet RAOs alone, but may be considered in conjunction with other technologies to form potential remedial actions (e.g., excavation in-the-dry, dewatering, and residuals management) that eventually meet RAOs. Dependent on removal efficiencies associated with residual activity levels achieved and degree of contaminant release during dredging. Removal of materials from Creek/River and land areas would result in immediate achievement of RAO #1. RAO #2 should be achieved through the use of engineering controls.	Would remove existing habitats, may result in increased residual activity levels at locations where greater activities exist at depth and/or as a result of contaminant release during implementation. Effects could be mitigated through the use of engineering controls. Would increase truck traffic in the area during removal. Potential risk of release and exposure also exists during material transport, handling, and processing.	Has been applied at other locations nationwide.	Implementable. Well suited for removal in River setting. Effective with rock and debris removal.	Permits not required under CERCLA, although substantive requirements should be met.	Moderate.
	Hydraulic	Does not meet RAOs alone, but may be considered in conjunction with other technologies to form potential remedial actions (e.g., excavation in-the-dry, dewatering, and residuals management) that eventually meet RAOs. Dependent on removal efficiencies associated with residual activity levels achieved and degree of contaminant release during dredging. Removal of materials from Creek/River and land areas would result in immediate achievement of RAO #1. RAO #2 should be achieved through the use of engineering controls.	Would remove existing habitats, may result in increased residual activity levels at locations where greater activities exist at depth and/or as a result of contaminant release during implementation. Effects could be mitigated through the use of engineering controls. Would increase truck traffic in the area during removal. Potential risk of release and exposure also exists during material transport, handling, and processing.	Has been applied at other locations nationwide.	Implementable. Well suited for removal in River setting. Certain water depths required for hydraulic dredging equipment. Presence of boulders and debris may limit effectiveness/ implementability.	Permits not required under CERCLA, although substantive requirements should be met.	Moderate to High.

Table 3-2

Kress Creek/West Branch DuPage River and Sewage Treatment Plant Sites
DuPage County, Illinois
Feasibility Study Report

Evaluation of Process Options for Sediment and Soil

General Response Action/Remedial Technology	Process Option	EFFECTIVENESS			IMPLEMENTABILITY		RELATIVE COST[1]
		Ability to Meet RAOs	Implementation Effects	How Proven and Reliable is the Technology?	Technical Feasibility	Administrative Feasibility	
F. Sediment/Soil Removal (cont'd)							
1. Dredging (cont'd)	Pneumatic	Does not meet RAOs alone, but may be considered in conjunction with other technologies to form potential remedial actions (e.g., excavation in-the-dry, dewatering, and residuals management) that eventually meet RAOs. Dependent on removal efficiencies associated with residual activity levels achieved and degree of contaminant release during dredging. Removal of materials from Creek/River and land areas would result in immediate achievement of RAO #1. RAO #2 should be achieved through the use of engineering controls.	Would remove existing habitats, may result in increased residual activity levels at locations where greater activities exist at depth and/or as a result of contaminant release during implementation. Effects could be mitigated through the use of engineering controls. Would increase truck traffic in the area during removal. Potential risk of release and exposure also exists during material transport, handling, and processing.	Not widely used, especially for environmental dredging.	Implementable. Generally requires 7 feet of water for operation. Presence of boulders and debris may limit effectiveness/implementability. Would need to be coupled with mechanical removal to manage large rocks/debris known to exist at the Sites.	Requires specialty equipment which is available on a limited basis.	High.
	Amphibious	Does not meet RAOs alone, but may be considered in conjunction with other technologies to form potential remedial actions (e.g., excavation in-the-dry, dewatering, and residuals management) that eventually meet RAOs. Dependent on removal efficiencies associated with residual activity levels achieved and degree of contaminant release during dredging. Removal of materials from Creek/River and land areas would result in immediate achievement of RAO #1. RAO #2 should be achieved through the use of engineering controls.	Would remove existing habitats, may result in increased residual activity levels at locations where greater activities exist at depth and/or as a result release contaminant release during implementation. Effects could be mitigated through the use of engineering controls. Would increase truck traffic in the area during removal. Potential risk of release and exposure also exists during material transport, handling, and processing.	Relatively new technology with limited applications. Could be reliable in difficult to access areas.	Implementable. Lower removal rates than other dredging equipment; weather dependent.	Requires specialty equipment which is available on a limited basis.	High.

Table 3-2

Kress Creek/West Branch DuPage River and Sewage Treatment Plant Sites
DuPage County, Illinois
Feasibility Study Report

Evaluation of Process Options for Sediment and Soil

General Response Action/Remedial Technology	Process Option	EFFECTIVENESS			IMPLEMENTABILITY		RELATIVE COST[1]
		Ability to Meet RAOs	Implementation Effects	How Proven and Reliable is the Technology?	Technical Feasibility	Administrative Feasibility	
F. Sediment/Soil Removal (cont'd)							
2. Excavation (in-the-dry)	Mechanical	Does not meet RAOs alone, but may be considered in conjunction with other technologies to form potential remedial actions (e.g., excavation in-the-dry, dewatering, residuals management) that eventually meet RAOs. Dependent on removal efficiencies associated with residual activity levels achieved and degree of contaminant release during removal. Removal of materials from Creek/River and land areas would result in immediate achievement of RAO #1. RAO #2 should be achieved through the use of engineering controls.	Would remove existing habitat, may result in increased residual activity levels at locations where greater activities exist at depth and/or as a result of contaminant release during implementation. Effects could be mitigated through the use of engineering controls. Increased potential for localized flooding exists. Greater removal precision than dredging through water column. Less potential for contaminant release than other removal methods with possible exception of catastrophic overtopping of cordoned off area. Potential risk of release and exposure also exists during material transport, handling, and processing.	Has been applied at other sites.	Implementable based on understanding of groundwater infiltration and water depths in Creek/River.	Permits not required under CERCLA, although substantive requirements should be met.	Moderate.
G. Sediment/Soil Dewatering							
1. Filtration	Plate and Frame Filter Press	Does not meet RAOs on its own, but may be necessary for removed sediments that are high in water content prior to disposal.	Minimal, assuming waste streams are properly managed. Possible worker exposure to contaminated sediment and water. Treated water likely would be discharged back to Creek/River.	Reliable, with proper pre-treatment steps.	Implementable.	Implementable.	Moderate.
G. Sediment/Soil Dewatering (cont'd)							
1. Filtration (cont'd)	Belt Filter Press	Does not meet RAOs on its own, but may be necessary for removed sediments that are high in water content prior to disposal.	Minimal, assuming waste streams are properly managed. Possible worker exposure to contaminated sediment and water. Treated water likely would be discharged back to Creek/River.	Reliable. A site-specific study would be required to assess treatment effectiveness.	Implementable.	Implementable.	Moderate.

Table 3-2

Kress Creek/West Branch DuPage River and Sewage Treatment Plant Sites
DuPage County, Illinois
Feasibility Study Report

Evaluation of Process Options for Sediment and Soil

General Response Action/Remedial Technology	Process Option	EFFECTIVENESS			IMPLEMENTABILITY		RELATIVE COST[1]
		Ability to Meet RAOs	Implementation Effects	How Proven and Reliable is the Technology?	Technical Feasibility	Administrative Feasibility	
G. Sediment/Soil Dewatering (cont'd)							
2. Centrifuge	Solid-Bowl	Does not meet RAOs on its own, but may be necessary for removed sediments that are high in water content prior to disposal.	Minimal, assuming waste streams are properly managed. Possible worker exposure to contaminated sediment and water. Treated water likely would be discharged back to Creek/River.	Historically, process has required frequent maintenance and often experienced operational difficulties. A site-specific study would be required to assess treatment effectiveness.	Implementable.	Implementable.	Moderate.
3. Hydrocyclone	Hydrocyclone	Does not meet RAOs on its own, but may be necessary for removed sediments that are high in water content prior to disposal.	Minimal, assuming waste streams are properly managed. Possible worker exposure to contaminated sediment and water. Treated water likely would be discharged back to Creek/River.	Reliable. A site-specific study would be required to assess treatment effectiveness.	Implementable for certain portions of removed sediment depending on sediment characteristics. Most effective on feed with high coarse particle content (i.e., sand) and solids content 5 to 25%.	Implementable.	Low to moderate.
4. Gravity Drainage	----	Does not meet RAOs on its own, but may be necessary for removed sediments that are high in water content prior to disposal.	Minimal, assuming waste streams are properly managed. Possible worker exposure to contaminated sediment and water. Treated water likely would be discharged back to Creek/River.	Reliable. A site-specific study would be required to assess treatment effectiveness.	Implementable.	Implementable.	Low.
H. Sediment/Soil Disposal							
1. Off-Site Disposal	Landfill	Does not meet RAOs alone, but can be used in conjunction with other technologies to form remedial actions (e.g., removal, dewatering, residuals management) that eventually would be expected to meet RAOs.	Effects could be reduced through use of proper engineering controls. Risks of exposure and transportation accidents increase with significantly increased haul distances of materials.	Widely used.	Implementable. Depends on landfill location, availability, and capacity.	Implementable.	Moderate to high.
I. Residuals Management							
1. Water Treatment	Filtration	Does not meet RAOs alone, but can be used in conjunction with other technologies to form remedial actions (e.g., removal, dewatering, disposal) that eventually would be expected to meet RAOs.	Minimal, assuming waste streams are properly managed. Possible worker exposure to contaminated sediment and water.	Reliable.	Implementable.	Implementable.	Low to moderate.

Notes:
1. Costs are relative to other process options within each general response action.

Table 3-3

Kress Creek/West Branch DuPage River and Sewage Treatment Plant Sites
DuPage County, Illinois
Feasibility Study Report

Representative Process Options

General Response Action/ Remedial Technology	Representative Process Option(s)
A) No Action	No Action
B) Monitoring and Institutional Controls	Site-Wide Monitoring Access and Deed Restrictions
C) Source Control/Natural Recovery Source Control Natural Recovery	 Source Control Natural Processes
D) In-Place Containment Cap/Cover	 Engineered Capping
E) Sediment/Soil Treatment Immobilization	 Ex-situ Stabilization/Solidification
F) Sediment/Soil Removal Dredging Excavation (in-the-dry)	 Mechanical Mechanical
G) Sediment/Soil Dewatering Gravity Drainage	 Gravity Drainage
H) Sediment/Soil Disposal Off-site Disposal	 Licensed Disposal Facility
I) Residuals Management Water Treatment	 Filtration

Table 4-1

Kress Creek/West Branch DuPage River and Sewage Treatment Plant Sites
DuPage County, Illinois
Feasibility Study Report

Preliminary Cost Estimate for Alternative 2:
Monitored Natural Recovery

Construction Total:	$0
Long-Term Monitoring/O&M Program (Present Worth):	$0.4 M
Total:	$0.4 M

See assumptions on Page 2.

Table 4-1 (Cont'd)

Kress Creek/West Branch DuPage River and Sewage Treatment Plant Sites
DuPage County, Illinois
Feasibility Study Report

Preliminary Cost Estimate for Alternative 2:
Monitored Natural Recovery

Assumptions:

1. This cost estimate assumes that no active remediation would be performed within the Sites. A 30-year monitoring program would be implemented to assess ongoing natural recovery processes within the Sites.
2. The long-term monitoring program would include surface gamma surveys of the Sites, specifically focusing on areas potentially subject to remediation, every 5 years for a period of 30 years (estimated at $100,000 per event). The estimated cost for the long-term monitoring program was calculated using the present worth analysis process outlined in the "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study" (USEPA, July 2000). A discount rate of 7% was used for the present worth calculation. In addition, it was assumed that $100,000 would be required for upfront legal fees to obtain access and deed restrictions.
3. Costs are provided in 2003 dollars.
4. Costs do not include property costs (if necessary), access costs (if necessary), permitting costs, legal fees, Agency oversight, and public relations efforts.

Table 4-2

Kress Creek/West Branch DuPage River and Sewage Treatment Plant Sites
DuPage County, Illinois
Feasibility Study Report

Alternative 3: Summary of Preliminary Material Volume Estimates

Geographic Location	Estimated Volume (cubic yards)						
	Sediment Materials		Floodplain Materials		Total		Total (Rounded)
	Targeted Material	Overburden Material	Targeted Material	Overburden Material	Targeted Material	Overburden Material	
Kress Creek: Outfall to May Street	1,700	500	5,000	1,400	6,700	1,900	9,000
Kress Creek: May Street to Joy Road	3,900	1,000	3,600	900	7,500	1,900	9,000
Kress Creek: Joy Road to Route 59	700	100	6,200	1,100	6,900	1,200	8,000
Kress Creek: Route 59 to Confluence	100	100	3,200	400	3,300	500	4,000
West Branch DuPage River: STP to Confluence	200	100	2,000	1,000	2,200	1,100	3,000
West Branch DuPage River: Confluence to Williams Road	1,000	600	11,200	7,100	12,200	7,700	20,000
West Branch DuPage River: Williams Road to Butterfield Road	700	900	1,300	1,600	2,000	2,500	5,000
West Branch DuPage River: Butterfield Road to Warrenville Dam	24,500	15,500	1,300	800	25,800	16,300	42,000
West Branch DuPage River: McDowell Grove Area	10,000	14,700	0	0	10,000	14,700	25,000
Rounded Total:	43,000	34,000	34,000	14,000	77,000	48,000	125,000

Notes:
1. Total surface areas were calculated by summing surface areas (obtained from ArcView) for all individual areas within a specified reach. Volumes were calculated using the average depth of overburden and targeted material provided for all boreholes within each area and multiplying by the total surface area.
2. Volumes were further separated by sediment or floodplain based on the percent of total surface area for each reach that exists within or outside of the Creek/River boundary.
3. The areal extent of targeted material is illustrated on Figure 2-1.
4. Kerr-McGee is performing additional characterization (i.e., surface scanning and if necessary, downhole drilling) in specific areas of the Sites, including the stretch of the River between the Warrenville and McDowell Dams. Volumes provided in this document do not take into account this future characterization, and therefore may require modification based on the results of the additional characterization work.

Table 4-3

Kress Creek/West Branch DuPage River and Sewage Treatment Plant Sites
DuPage County, Illinois
Feasibility Study Report

Preliminary Cost Estimate for Alternative 3:
Excavation and Off-Site Disposal of Targeted Sediment/Soil throughout the Sites

ITEM NO.	DESCRIPTION	UNIT	NO. OF UNITS	UNIT COST	ESTIMATED COST
1	General Expenses	LS	1	$15,000,000	$15,000,000
2	Pre-Design Investigations	LS	1	$600,000	$600,000
3	Site Preparation	LS	1	$2,400,000	$2,400,000
4	Temporary Sedimentation and Erosion Control Area for Filtering	LS	1	$730,000	$730,000
5	Dewatering System	LS	1	$7,700,000	$7,700,000
6	Overburden Excavation/Staging (Creek/River Sediments and Floodplain Materials)	CY	48,000	$20	$960,000
7	Targeted Sediment Excavation/Staging/Transport and Disposal	CY	44,000	$315	$13,860,000
8	Targeted Floodplain Material Removal/Staging/ Transport and Disposal	CY	38,000	$275	$10,450,000
9	Sediment Stabilization	TON	68,400	$25	$1,710,000
10	Material Loading	CY	77,000	$15	$1,155,000
11	Backfill	CY	67,000	$15	$1,005,000
12	Site Restoration	LS	1	$2,740,000	$2,740,000
13	Construction Monitoring/Oversight	MO	32	$30,000	$960,000
				Construction Total:	$59.3 M
				Engineering Design:	$1.8 M
				Contingency:	$11.9 M
	Long-Term Monitoring/O&M Program (Present Worth):				$0.7 M
				Total:	$73.7 M

See assumptions on Page 2.

Table 4-3 (Cont'd)

Kress Creek/West Branch DuPage River and Sewage Treatment Plant Sites
DuPage County, Illinois
Feasibility Study Report

Preliminary Cost Estimate for Alternative 3: Excavation and Off-Site Disposal of Targeted Sediment/Soil throughout the Sites

General Assumptions:

1. Under this alternative, excavation activities would be performed using mechanical excavation techniques within discrete manageable reaches. Targeted areas would be isolated or contained using silt curtains, sand bags, earthen berms, and/or sheetpiling, as appropriate, and dewatered to allow excavation in the dry. Complete excavation of overburden and targeted materials would be performed in a stepwise manner upstream to downstream within the discrete reaches prior to moving to the next reach. At each location, overburden materials would be excavated first, followed by targeted material.
2. Work to be conducted 6 days per week.
3. All costs are provided in 2003 dollars and all capital cost expenditures are assumed to occur in 2003.
4. Costs do not include property costs (if necessary), access costs (if necessary), permitting costs, legal fees, Agency oversight, and public relations efforts.
5. Engineering and design fees estimated at 5% of construction and restoration costs (i.e., construction monitoring/oversight and transportation and off-site material transportation and disposal costs are not included).
6. A 20% contingency fee has been included to account for unforeseen circumstances or variability in volumes, labor, or material cost.

Specific Assumptions:

1. The line item for general expenses includes the following components (the approximate percentage of the total line item cost that is associated with each component is provided in parenthesis): mobilization/demobilization along with decontamination of equipment (5%), temporary facilities and installation of electrical systems (5%), health and safety (20%), surveying (5%), radiological testing (1%), taxes (5%), and contractor overhead (25%), and expenses and other fees such as indirect job labor, general expenses, and profit (34%).
2. Pre-design investigations would be performed prior to implementation of remedial activities at an estimated cost of $75,000 per reach.
3. Site preparation activities include clearing and grubbing, and construction of access and haul roads. During clearing and grubbing, all trees and brush located within areas required to complete excavation activities would be cleared. Chipped trees and stumps would be left on site. Access and haul roads would be constructed to a width of approximately 16 feet using geotextile (and/or geogrid in soft areas) and stone. Staging areas would be constructed using a liner, geotextile and stone, asphalt, and would be bermed around the perimeter for containment. The approximate breakdown of the total line item estimated cost is as follows: 5% for clearing and grubbing, 60% for construction of access and haul roads, and 35% for construction of staging areas.
4. The temporary sedimentation and erosion control area for filtering would include construction of a water filtering system and placement of silt curtains to mitigate migration of suspended solids during construction. The temporary sedimentation control system is assumed to consist of sand and carbon filters, polymer system, pumps, and a storage tank. A silt curtain would be installed downstream of the work areas and anchored into shore. Approximately 95% of the total estimated line item cost is for construction and operation of the water filtering system with the remaining 5% comprised of silt curtain purchase and installation.
5. The assumed dewatering system for the Creek/River would include either a pump bypass system including a dewatering pump and pipe along with sheetpiling, earthen berms, silt curtains, and/or sand bags as appropriate or a sheetpile diversion system along with excavation dewatering sumps/piping, as appropriate. Both of these systems would include two different dewatering components - dewatering the Creek/River area targeted for excavation and dewatering excavated materials (via gravity drainage at the staging area). Note the actual diversion method will be determined during detailed design. The lump sum cost is comprised of 45% for dewatering associated with construction and operation of the required pump bypass systems and 55% for dewatering associated with the required sheetpile diversion systems.
6. All overburden materials from the Creek/River bed and floodplain areas have been assumed to be excavated through the use of backhoes at a rate of 400 cubic yards per day (cy/day). Materials would be loaded and transported to the on-site staging area, where they would be staged for future use as backfill.
7. All targeted sediment materials have been assumed to be excavated through the use of backhoes at a rate of 200 cy/day. Materials would be loaded and transported to the on-site staging area, where they would be staged for off-site disposal. Off-site material transportation and disposal includes disposal of excavated targeted sediment and stone in direct contact within the materials requiring disposal. Includes trucking to trans-shipment point, railcar loading, rail shipping, and disposal.
8. All targeted floodplain materials have been assumed to be excavated through the use of backhoes at a rate of 400 cy/day. Materials would be loaded and transported to the on-site staging area, where they would be staged for off-site disposal. Off-site material transportation and disposal includes disposal of excavated targeted soil material and stone in direct contact within the materials requiring disposal. Includes trucking to trans-shipment point, railcar loading, rail shipping, and disposal.

Table 4-3 (Cont'd)

Kress Creek/West Branch DuPage River and Sewage Treatment Plant Sites
DuPage County, Illinois
Feasibility Study Report

Preliminary Cost Estimate for Alternative 3:
Excavation and Off-Site Disposal of Targeted Sediment/Soil throughout the Sites

9. It has been assumed that sediment materials requiring off-site disposal would be stabilized through the use of quicklime (15% by weight would be added). Sediment and quicklime would be blended at the on-site staging areas with a backhoe. The tonnage provided represents the weight of sediment including the additive tonnage of quicklime.

10. All materials requiring off-site disposal would be loaded from the staging area with a backhoe into dump trucks for transport to a disposal transfer station. It is assumed that the material would be handled a second time at the transfer station for loading for off-site disposal.

11. Excavated bank and floodplain areas would be backfilled to original grades with a combination of overburden material and materials available locally (assumed available in sufficient quantity) using a front end loader. The backfilled areas would be graded with a bulldozer. Select sediment areas would be filled within 2 feet of original grade using overburden or imported fill materials to maintain stability where deep excavations may exist.

12. All disturbed areas in the floodplain would be appropriately restored and revegetated to the extent practicable based on location characteristics (i.e., high or low energy aquatic environment, floodplain, residential, or forest preserve areas) and considering pre-remedial conditions. The restoration lump sum line item is comprised of the following breakdown: 45% for streambanks, 10% for residential/commercial properties, and 45% for forest preserves.

13. Construction monitoring and oversight would include daily oversight of all construction activities and air and water column monitoring.

14. The long-term monitoring/operation and maintenance program is assumed to include an annual monitoring and maintenance period for wetlands and other areas (i.e., forested uplands, low and high energy stream banks) for 3 years (estimated at approximately $250,000 per event), and maintenance of residential/commercial areas for 1 year (estimated at approximately $10,000). The estimated cost for the long-term monitoring program was calculated using the present worth analysis process outlined by the USEPA (July 2000). A discount rate of 7% was used for the present worth calculation.

Table 4-4

Kress Creek/West Branch DuPage River and Sewage Treatment Plant Sites
DuPage County, Illinois
Feasibility Study Report

Alternative 4: Summary of Preliminary Volume and Area Estimates

Geographic Location	Estimated Volume to be Removed to Facilitate Capping (cubic yards)					Estimated Areal Extent of Capping (acres)	
	Sediment Materials		Floodplain Materials		Total (Rounded)		
	Targeted Material	Overburden Material	Targeted Material	Overburden Material		Floodplain	Sediment
Kress Creek: Outfall to May Street	1,700	500	4,000	1,400	8,000	1.4	<0.01
Kress Creek: May Street to Joy Road	3,900	900	3,600	800	9,000	1.2	<0.01
Kress Creek: Joy Road to Route 59	700	100	5,900	1,000	8,000	2.7	<0.01
Kress Creek: Route 59 to Confluence	100	100	3,200	400	4,000	1.5	0
West Branch DuPage River: STP to Confluence	200	100	1,900	1,000	3,000	1.0	<0.01
West Branch DuPage River: Confluence to Williams Road	900	300	9,700	3,100	14,000	4.5	0.04
West Branch DuPage River: Williams Road to Butterfield Road	700	900	1,000	1,600	4,000	0.7	0.09
West Branch DuPage River: Butterfield Road to Warrenville Dam	12,700	15,500	400	800	29,000	0.3	5.6
West Branch DuPage River: McDowell Grove Area	100	5,600	0	0	6,000	0	3.2
Rounded Total:	21,000	24,000	30,000	10,000	85,000	13.3	8.9

Notes:
1. Total surface areas were calculated by summing surface areas (obtained from ArcView) for all individual areas within a specified reach. Volumes were calculated using the average depth of overburden and targeted material provided for all boreholes within each area and multiplying by the total surface area.
2. Volumes were further separated by sediment or floodplain based on the percent of total surface area for each reach that exists within or outside of the Creek/River boundary.
3. The areal extent of targeted material is illustrated on Figure 2-1.
4. Kerr-McGee is performing additional characterization (i.e., surface scanning and if necessary, downhole drilling) in specific areas of the Sites, including the stretch of the River between the Warrenville and McDowell Dams. Volumes provided in this document do not take into account this future characterization, and therefore may require modification based on the results of the additional characterization work.

Table 4-5

Kress Creek/West Branch DuPage River and Sewage Treatment Plant Sites
DuPage County, Illinois
Feasibility Study Report

Preliminary Cost Estimate for Alternative 4:
Capping of Targeted Sediment/Soil throughout the Sites

ITEM NO.	DESCRIPTION	UNIT	NO. OF UNITS	UNIT COST	ESTIMATED COST
1	General Expenses	LS	1	$16,500,000	$16,500,000
2	Pre-Design Investigations	LS	1	$800,000	$800,000
3	Site Preparation	LS	1	$2,400,000	$2,400,000
4	Temporary Sedimentation and Erosion Control Area for Filtering	LS	1	$510,000	$510,000
5	Dewatering System	LS	1	$8,100,000	$8,100,000
6	Overburden Excavation/Staging (Creek/River Sediments and Floodplain Materials)	CY	34,000	$20	$680,000
7	Targeted Sediment Excavation/Staging/Transport and Disposal	CY	22,000	$315	$6,930,000
8	Targeted Floodplain Material Excavation/Staging/ Transport and Disposal	CY	34,000	$275	$9,350,000
9	Sediment Stabilization	TON	30,400	$25	$760,000
10	Material Loading	CY	51,000	$15	$765,000
11	Purchase/Placement of Geotextile in Creek/River	SY	47,000	$2.50	$117,500
12a	Purchase/Placement of Cap in Creek/River	CY	26,000	$35	$910,000
12b	Purchase/Placement of Armor Layer in Creek/River	CY	7,000	$30	$210,000
13	Purchase/Placement of Cap in Floodplain Areas	CY	42,000	$15	$630,000
14	Site Restoration	LS	1	$2,740,000	$2,740,000
15	Construction Monitoring/Oversight	MO	32	$30,000	$960,000
				Construction Total:	$52.4 M
				Engineering Design:	$2.4 M
				Contingency:	$10.5 M
				Long-Term Monitoring/O&M Program (Present Worth):	$1.8 M
				Total:	$67.1 M

See assumptions on Page 2.

Table 4-5 (Cont'd)

Kress Creek/West Branch DuPage River and Sewage Treatment Plant Sites
DuPage County, Illinois
Feasibility Study Report

Preliminary Cost Estimate for Alternative 4: Capping of Targeted Sediment/Soil throughout the Sites

General Assumptions:

1. Under this alternative, a cap would be placed over all targeted sediment and floodplain areas through mechanical means within discrete manageable reaches. Within each reach, excavation of targeted material would be performed to facilitate cap placement. Following excavation, required cap materials would be placed in a stepwise manner upstream to downstream within the discrete reaches prior to moving to the next reach.
2. Work to be conducted 6 days per week.
3. All costs are provided in 2003 dollars and all capital cost expenditures are assumed to occur in 2003.
4. Costs do not include property costs (if necessary), access costs (if necessary), permitting costs, legal fees, Agency oversight, and public relations efforts.
5. Engineering and design fees estimated at 5% of construction and restoration costs (i.e., construction monitoring/oversight and transportation and off-site material transportation and disposal costs are not included).
6. A 20% contingency fee has been included to account for unforeseen circumstances or variability in volumes, labor, or material cost.

Specific Assumptions:

1. The line item for general expenses includes the following components (approximate percentage each component is of the total line item cost provided in parenthesis): mobilization/demobilization along with decontamination of equipment (5%), temporary facilities and installation of electrical systems (5%), health and safety (20%), surveying (5%), radiological testing (1%), taxes (5%), and contractor overhead (25%), and expenses and other fees such as indirect job labor and general expenses and profit (34%).
2. Pre-design investigations would be performed prior to implementation of remedial activities at an estimated cost of $100,000 per reach.
3. Site preparation activities include clearing and grubbing, and construction of access and haul roads. During clearing and grubbing, all trees and brush located within areas required to complete excavation activities would be cleared. Chipped trees and stumps would be left on site. Access and haul roads would be constructed to a width of approximately 16 feet using geotextile (and/or geogrid in soft areas) and stone. Staging areas would be constructed using a liner, geotextile and stone, asphalt, and would be bermed around the perimeter for containment. The approximate breakdown of the total line item estimated cost is as follows: 5% for clearing and grubbing, 60% for construction of access and haul roads, and 35% for construction of staging areas.
4. The temporary sedimentation and erosion control area for filtering would include construction of a water filtering system and placement of silt curtains to mitigate migration of suspended solids during construction. The temporary sedimentation control system is assumed to consist of sand and carbon filters, polymer system, pumps, and a storage tank. A silt curtain would be installed downstream of the work areas and anchored into shore. Approximately 95% of the total estimated line item cost is for construction and operation of the water filtering system with the remaining 5% comprised of silt curtain purchase and installation.
5. The assumed dewatering system for the Creek/River would include either a pump bypass system including a dewatering pump and pipe along with sheetpiling, earthen berms, silt curtains, and/or sand bags as appropriate or a sheetpile diversion system along with excavation dewatering sumps/piping, as appropriate. Both of these systems would include two different dewatering components - dewatering the Creek/River area targeted for excavation and dewatering excavated materials (via gravity drainage at the staging area). Note the actual diversion method will be determined during detailed design. The lump sum cost is comprised of 45% for dewatering associated with construction and operation of the required pump bypass systems and 55% for dewatering associated with the required sheetpile diversion systems.
6. Required overburden materials from the Creek/River bed and floodplain areas have been assumed to be excavated to provide adequate depth for cap placement through the use of backhoes at a rate of 400 cubic yards per day (cy/day). Materials would be loaded and transported to the on-site staging area, where it would be staged for future use as backfill.
7. All targeted sediment materials have been assumed to be excavated through the use of backhoes at a rate of 200 cy/day. Materials would be loaded and transported to the on-site staging area, where it would be staged for off-site disposal. Off-site material transportation and disposal includes disposal of excavated targeted sediment and stone in direct contact within the materials requiring disposal. Includes trucking to trans-shipment point, railcar loading, rail shipping, and disposal.
8. All targeted floodplain materials have been assumed to be excavated through the use of backhoes at a rate of 400 cy/day. Materials would be loaded and transported to the on-site staging area, where it would be staged for off-site disposal. Off-site material transportation and disposal includes disposal of excavated targeted soil material and stone in direct contact within the materials requiring disposal. Includes trucking to trans-shipment point, railcar loading, rail shipping, and disposal.

Table 4-5 (Cont'd)

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9. It has been assumed that sediment materials requiring off-site disposal would be stabilized through the use of quicklime (15% by weight would be added). Sediment and quicklime would be blended at the on-site staging areas with a backhoe. The tonnage provided represents the weight of sediment including the additive tonnage of quicklime.
10. All materials requiring off-site disposal would be loaded from the staging area with a backhoe into dump trucks for transport to a disposal transfer station. It is assumed that the material would be handled a second time at the transfer station for loading for off-site disposal.
11. It has been assumed that a woven geotextile fabric (minimum of 200 lb tensile strength) would be placed as a base layer between the cap and native sediments within the Creek/River to serve as both a separation layer and provide stability. The surficial coverage area includes an additional 10% for overlap of the geotextile fabric.
12. For purposes of this cost estimate it is assumed that the cap would be placed a top the geotextile in all targeted areas within the Creek/River, and would consist of 2 feet of a combination of overburden material and imported fill (assumed available from a local source) with an additional 6 inches of armoring materials such as gravels/cobbles.
13. For purposes of this cost estimate it is assumed that the cap in all targeted floodplain areas would consist of 2 feet of a combination of overburden material and imported fill (assumed available from a local source).
14. All disturbed areas in the floodplain would be appropriately restored and revegetated to the extent practicable based on location characteristics (i.e., high or low energy aquatic environment, floodplain, residential, or forest preserve areas) and considering pre-remedial conditions. The restoration lump sum line item is comprised of the following breakdown: 45% for streambanks, 10% for residential/commercial properties, and 45% for forest preserves.
15. Construction monitoring and oversight would include daily oversight of all construction activities and air and water column monitoring.
16. The long-term monitoring/operation and maintenance program is assumed to include annual monitoring and maintenance of wetlands and other areas (i.e., forested uplands, low and high energy stream banks) for 3 years (estimated at approximately $250,000 per event), and maintenance of residential/commercial areas for 1 year (estimated at approximately $10,000). It is also assumed that surface gamma surveys of the Sites (focusing on targeted areas; estimated at approximately $100,000 per event), bathymetry estimated at approximately $100,000 per event), and cap observation/maintenance (estimated at approximately $200,000 per event) would be performed once every 5 years for a period of 30 years. The estimated cost for the long-term monitoring program was calculated using the present worth analysis process outlined by the USEPA (July 2000). A discount rate of 7% was used for the present worth calculation. In addition, it was assumed that $100,000 would be required for upfront legal fees to obtain access and deed restrictions.